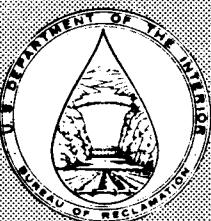


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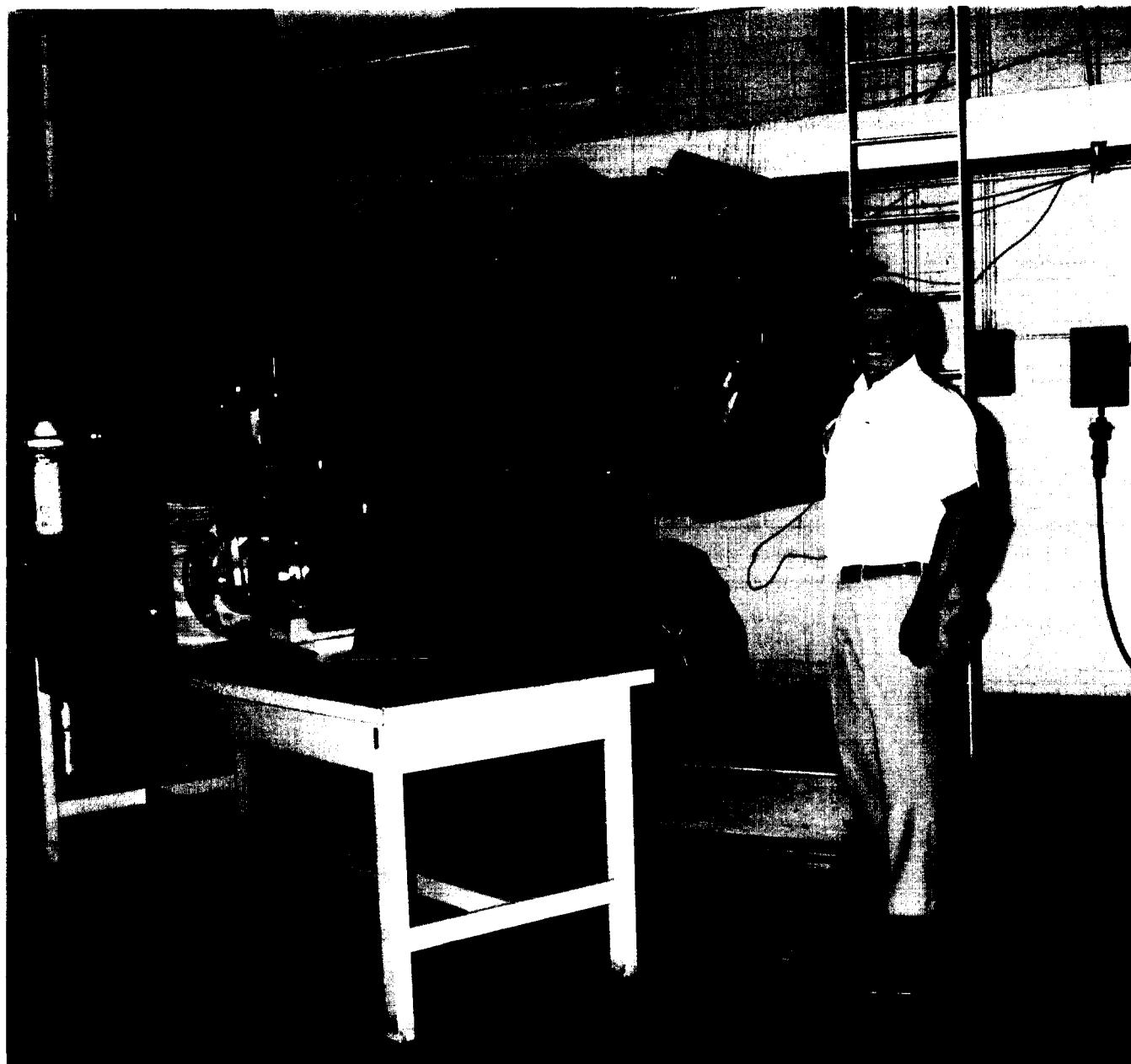
# LABORATORY TESTS ON THE 30-INCH CLAMSHELL GATE FOR GRASSY LAKE DAM

August 1990

**U.S. DEPARTMENT OF THE INTERIOR**  
**Bureau of Reclamation**  
**Denver Office**  
**Research and Laboratory Services Division**  
**Hydraulics Branch**

## TECHNICAL REPORT STANDARD TITLE PAGE

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| 16. ABSTRACT<br><br>Bureau of Reclamation personnel conducted laboratory tests on the 30-inch clamshell gate for Grassy Lake Dam to correct an excessive leakage problem when the gate was closed. During initial testing at the factory, the gate showed leakage far in excess of the specified maximum of 3 gal/min. With the agreement of the Pacific Northwest Region and the Denver Office Mechanical Branch, the gate was brought to the hydraulic laboratory for further testing. Initial leakage amounts were measured. A modification to the seal bars was installed and tested. Strain gauges were installed at nine locations on the gate and operator. Stress measurements from the strain gauges were compared with a finite element model of the gate leaf which was prepared by the Mechanical Branch. Gate operation was observed for very small openings. A minimum opening recommendation was arrived at through these observations. |                             |  |                               |
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Clamshell gate - 8-inch laboratory development model and 30-inch prototype for Grassy Lake Dam.



**R-90-16**

**LABORATORY TESTS ON THE  
30-INCH CLAMSHELL GATE  
FOR GRASSY LAKE DAM**

by

**Jerry R. Fitzwater  
K. Warren Frizell**

Hydraulics Branch  
Research and Laboratory Services Division  
Denver Office  
Denver, Colorado

August 1990

## **ACKNOWLEDGMENTS**

This study was performed with the cooperation of Dan Wilson, Boise Office, PN Region. Joe Martino and Wayne Delzer of the Mechanical Branch, Denver Office, provided technical assistance throughout the testing. Joe Martino prepared the finite element model. Rod Wittler of the Hydraulics Branch computed the discharge curves, and Lee Elgin, also of the Hydraulics Branch, assisted in the strain gauging. Wayne Lambert took the photographs.

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## **PURPOSE**

Factory pressure tests of the first prototype of a clamshell gate (30-inch) revealed leakage through the closed gate was in excess of the 3 gal/min prescribed in the specification. Preliminary measurements showed deflections of about 30 mils present at the seating surfaces along the gate centerline due to radial deflection of the gate leaves. The PN Region and the Mechanical Branch of the Denver Office agreed to bring the gate into Reclamation's hydraulic laboratory where research was conducted to modify the seal and measure stresses for comparison with a finite element model. Results of these tests can be used in future designs.

## **INTRODUCTION**

The clamshell gate was developed in the late 1970's from an 8-inch laboratory model at Reclamation's Denver Office hydraulic laboratory. The clamshell gate is fully described under U.S. Patent No. 3,998,426 issued to Thomas John Isbester on December 21, 1976, with license to the Government dated April 21, 1977 (Isbester, 1981).

The clamshell gate was conceived to help reduce problems in controlling high velocity flow, primarily to control cavitation damage. In addition, a high discharge coefficient and good debris passing characteristics were achieved. The gate can be used for both free and submerged discharges. In-line operation is also possible when an expansion chamber is used downstream from the gate. Applications for the gate include river outlet works and other large conduits where control of high pressure flows is required. The gate is well suited to operate at partial openings without adverse effects.

This first prototype clamshell gate will be installed on the outlet works at Grassy Lake Dam on the Upper Snake River Project, located on the south boundary of Yellowstone National Park in Wyoming (Pomeroy, 1946). This 30-inch gate will replace the existing 30-inch needle valve (36-inch-diameter inlet/30-inch-diameter outlet).

## **CONCLUSIONS AND RECOMMENDATIONS**

- Initial leakage was well in excess of the specified 3 gal/min.
- A simple seal modification was developed using rubber gasket material. Pressure testing revealed no leakage at the normal operating head. The seal can easily be replaced and has no adverse effect on the gate's performance.
- Strain gauge measurements correlated reasonably well with the finite element model. This will ensure that future designs for larger gates can be developed with the aid of computer modeling.
- Operational tests at small openings yielded a minimum gate operating point due to deflection and oscillation of the jet's nappe. The minimum recommended opening is 2 percent or 0.5 inch.

- Discharge curves were developed for the clamshell gate and show a 9-percent increase in flow over the existing 30-inch needle valve. This increase in flow should not cause any problems with scour in the stilling basin.

## **LABORATORY TESTS**

The gate was installed on a 12-inch line on the hydraulic laboratory system (fig. 1). Flow conditions in the gate were not considered since the main emphasis of the test program involved hydrostatic tests at a pressure of 45 lb/in<sup>2</sup>. A hydraulic oil pump system capable of pressures up to 1,000 lb/in<sup>2</sup> was used to operate the gate cylinders to provide for opening and closing.

### **Leakage Tests**

The clamshell gate was first tested with the original seal configuration. With the gate closed, dewatered, and the hydraulic control system relaxed, a gap of 5 mils was measured with a feeler gauge at the gate centerline. The gate was then pressurized to approximately 50 lb/in<sup>2</sup>. Leakage of 160 gal/min was measured through a 4-inch venturi meter (fig. 2). A second leakage test was performed with 1,000 lb/in<sup>2</sup> of pressure on the hydraulic cylinders. The leakage was reduced to 118 gal/min. Inspection reports from the manufacturer indicated that, at maximum internal pressure, there was about a 30-mil opening between seal bars, on the gate centerline. During the laboratory test, observations indicated that there was a radial deflection of the gate leaves, causing the gap at the centerline to increase as the gate was pressurized. During these tests, the leakage at the peripheral seal around the edge of the gate was minimal.

### **Seal Bar Modifications**

Modification to the seal bars appeared to be the only feasible method of solving the leakage problem. The possible widening of the 3/16-inch lip of the seal bars was discussed with the gate's inventor and it was agreed that it would not affect the performance of the gate, nor create a cavitation problem. A modification of the seal bars to include a rubber seal was made (fig. 3). The addition to the seal bars was constructed and attached to the gate (fig. 4). A short length of O-ring material (0.50 inch long) was also installed on each side of the seal bar to coincide with the peripheral gate seal at the closed position. These O-rings seal a small side stream of leakage when the gate is closed. Leakage tests were repeated. With the gate closed, hydraulic control system relaxed, and internally pressurized to 50 lb/in<sup>2</sup>, there was essentially no leakage. The gasket material forming the rubber seat can easily be replaced if damaged in any manner.

### **Finite Element Model and Stress Measurements**

A FEM (finite element model) of the gate leaf was created using SDRC's (Structural Dynamics Research Corporation) IDEAS-SUPERTAB software. Because of symmetry, only one-half of one gate leaf was modeled. The model was constructed on centerline planes using thin shell quadrilateral elements. Two loading conditions were tested: (1) hydrostatic pressure of 45 lb/in<sup>2</sup> and (2) hydrostatic pressure plus a point load representing the hydraulic cylinder force. Output from the model in the form of stress contours and deflections are shown on figures 5 and 6. Review of the model results identified nine locations for strain gauges. Bondable strain gauges with an active length of 0.125 inch were mounted on the clamshell gate (fig. 7). Gauges No. 7 and 8

were mounted on the arm associated with the instrumented leaf. Excitation and amplification were provided with Vishay 2100 amplifiers. Data were recorded with a portable DAT (digital audio tape) recorder and a 8-channel strip chart recorder. Results from the strain gauges due to the hydrostatic loading are shown in table 1 along with comparisons with the finite element model. Note the influence of the hydraulic operator on the stress readings. The application of a point load in the FEM only approximates the operator force, thus the differences in the measured vs. FEM results.

### **Operational Tests - Small Openings**

Operational tests of the clamshell gate in the laboratory were limited due to the laboratory's pumping capacity. The seal modification extended a rubber seat 0.09 inch into the flow past the original design. At small openings, this affects the jet trajectory coming from the gate. The jet is deflected upward at openings of 0.5 inch and less. In addition, oscillation of the jet begins. Although this oscillation did not appear to cause any vibration or operational problems, openings less than 2 percent (0.5 inch) should be avoided. At Grassy Lake this should not be a problem because the flow at a 2-percent opening is only about  $5 \text{ ft}^3/\text{s}$ , and operations will not require flows this small.

### **Discharge Curves**

Discharge curves for the clamshell gate were computed (fig. 8). The 30-inch clamshell gate passes 9 percent more flow than the existing 30-inch needle valve (36-inch inlet area) (fig. 9). However, the increased discharge capacity is not expected to adversely affect scour in the stilling basin. A tabulation of flow vs. reservoir elevation in 0.1-foot increments is also included for reference in the appendix. The program HDCOW written by R. Wittler was used to compute the curves. This program accounts for losses in each element of the hydraulic system leading up to and including the clamshell gate.

The discharge coefficients for the clamshell gate are given in the appendix in 10-percent increments. At a 100-percent opening, the coefficient is assumed to be 1.0 because the gate offers no obstruction to the flow.

### **BIBLIOGRAPHY**

Isbester, T. J., "Clamshell Gate," Hydraulics Branch Internal Memorandum PAP-423, Bureau of Reclamation, Denver, Colorado, November 1981.

Pomeroy, R. R., *Hydraulic Model Studies of Grassy Lake Dam Outlet Works and Spillway, Upper Snake River Project, Wyoming*, Hydraulic Laboratory Report No. Hyd.-226, Bureau of Reclamation, Denver, Colorado, December 1946.



**Table 1. - Stress measurements and finite element results**  
 Refer to fig. 7 for gauge location +tension/-compression.

| Gauge No. | Principal stresses (@ 45 lb/in <sup>2</sup> ) |                        |                                   |
|-----------|---|------------------------|-----------------------------------|
|           | Measurements*                                 | FEM**<br>(hydrostatic) | FEM**<br>(hydrostatic + operator) |
| 1         | +862  | +245                   | +860                              |
| 2         | +11447  | +12800                 | +6850                             |
| 3         | +13529  | +12800                 | +13800                            |
| 4         | +11864  | +10200                 | +17300                            |
| 5         | -5300   | -4540                  | +360                              |
| 6         | +5134   | +5080                  | +11500                            |
| 9         | +9435   | +2010                  | +30900                            |
| 9         | +20663***                                     |                        |                                   |

\* Measured values were taken with 45 lb/in<sup>2</sup> of internal pressure and about 700 lb/in<sup>2</sup> on the hydraulic cylinders.

\*\* FEM results are for cases of hydrostatic pressure (45 lb/in<sup>2</sup>) only and the same hydrostatic load plus 1,000 lb/in<sup>2</sup> of hydraulic cylinder pressure.

\*\*\* This value was taken with 45 lb/in<sup>2</sup> of internal pressure and 1,000 lb/in<sup>2</sup> on the hydraulic system.

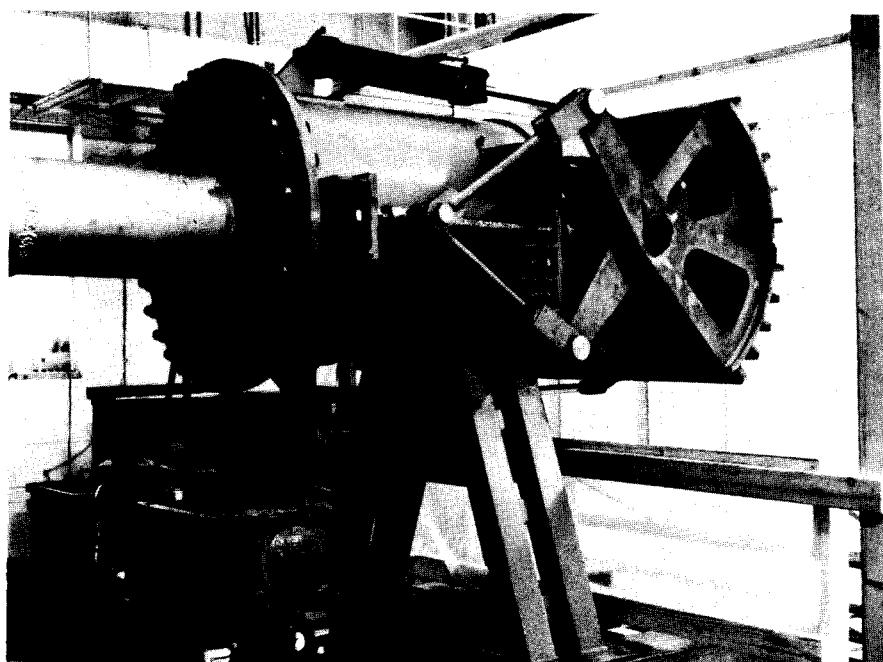


Figure 1. - Laboratory installation of the 30-inch clamshell gate.

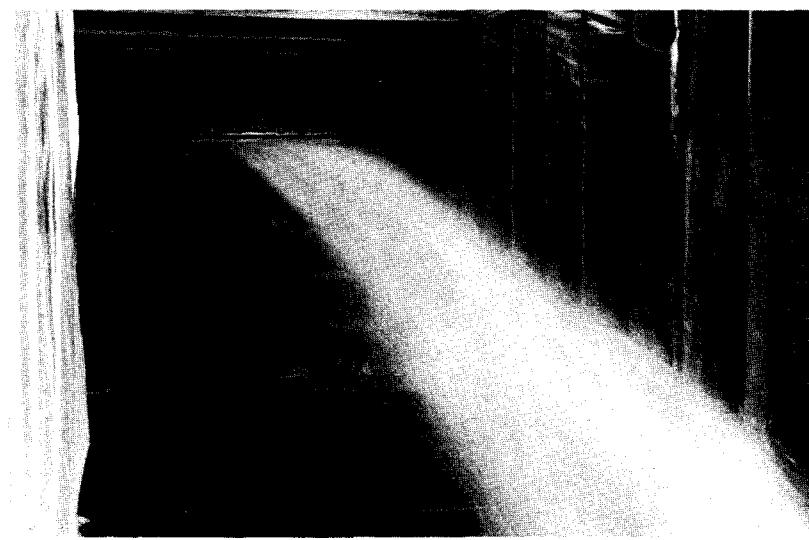
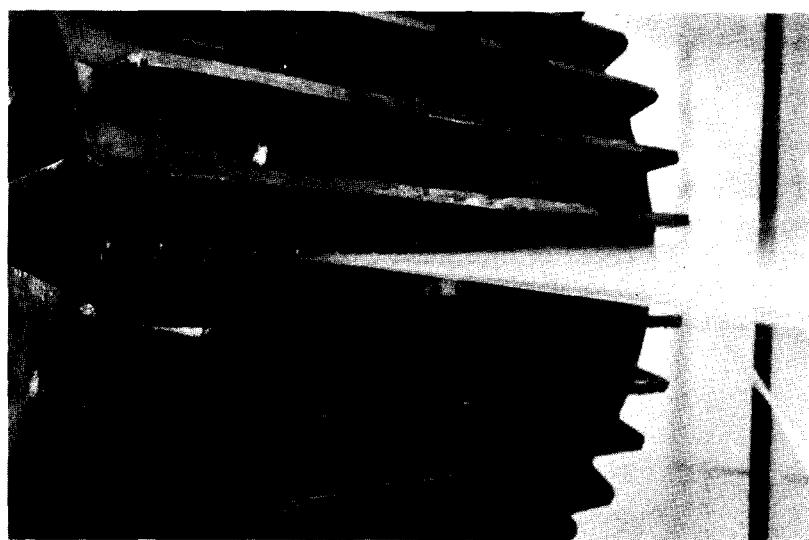


Figure 2. - Original seal bar configuration - leakage.

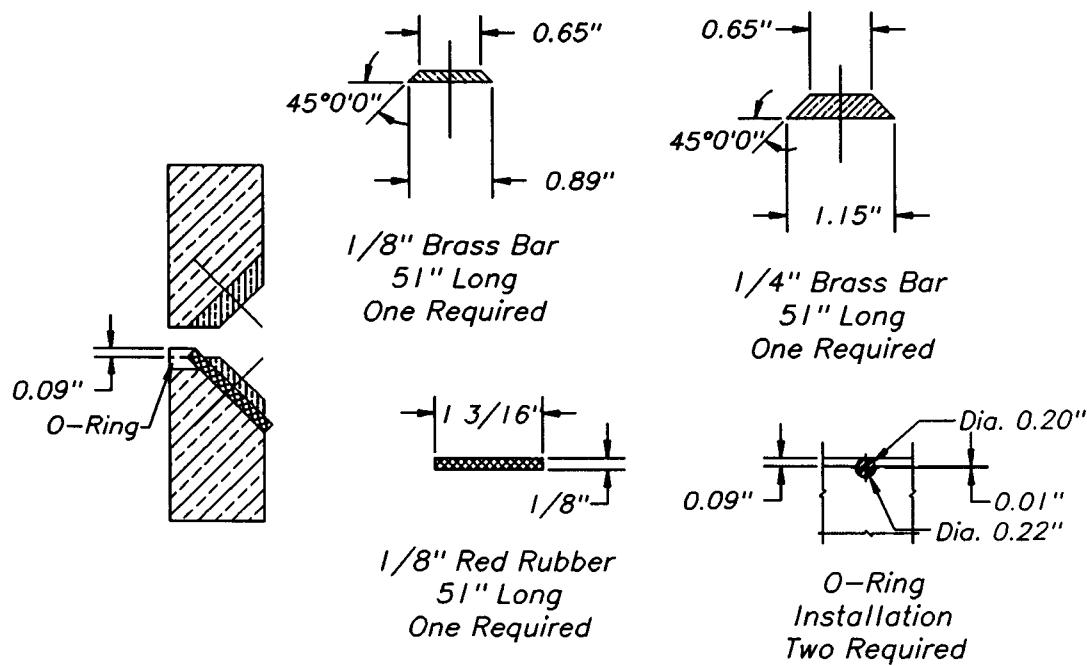


Figure 3. - Seal bar modifications.

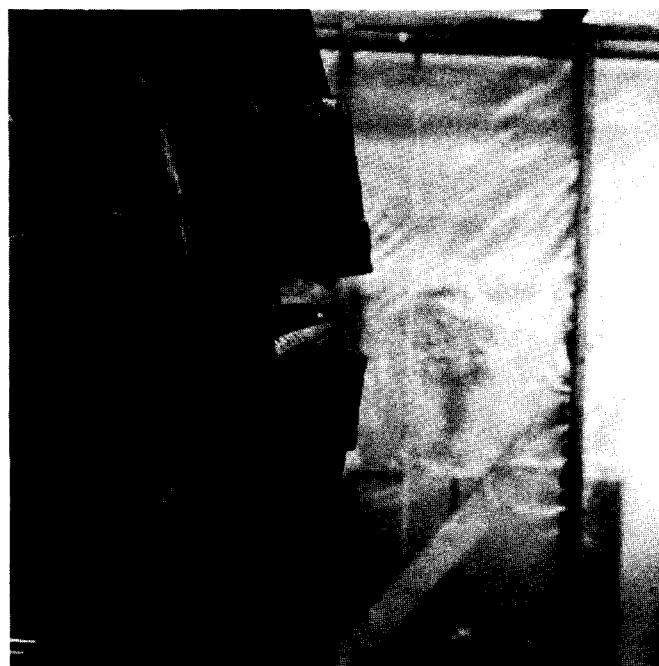


Figure 4. - Modified seal bar configuration.



LOADCASE 1  
FRAME OF REF GLOBAL  
STRESS - MAX PRIN MIN -1.77E+03 MAX 1.28E+04

## 30-INCH CLAMSHELL GATE LEAF MODEL

SHELL SURFACE TOP

6

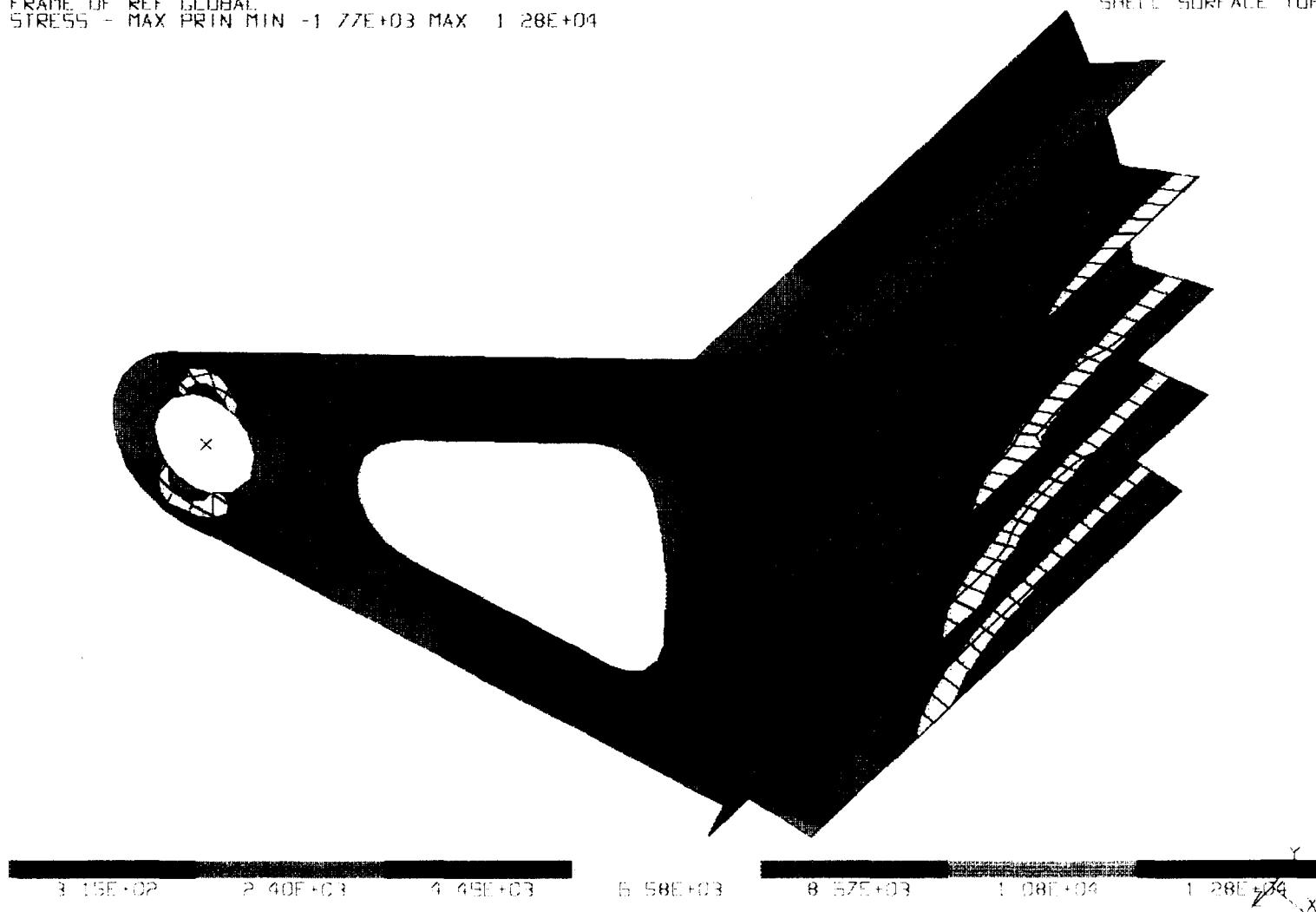


Figure 5. - Stress contours from finite element model, hydrostatic load only, stress in lb/in<sup>2</sup>.



LOADCASE 1  
DISPLACEMENT - MAG MIN 1 31E-03 MAX 4 88E-02

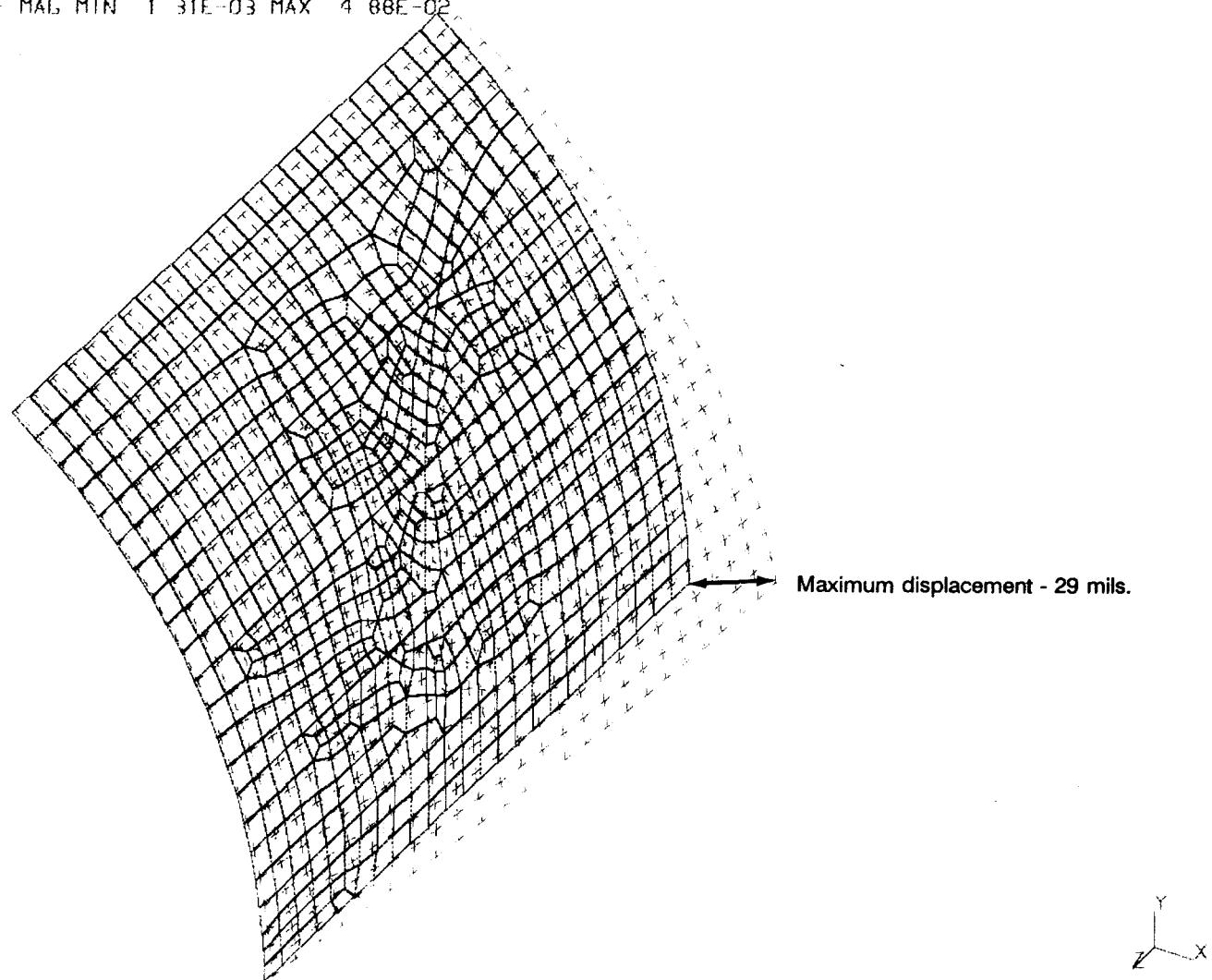


Figure 6. - Deflections computed from finite element model (stiffeners not shown).



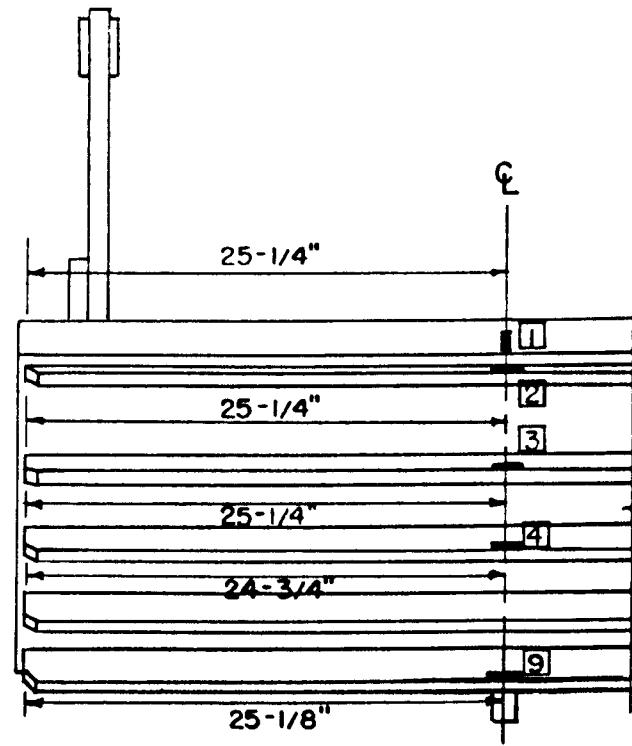
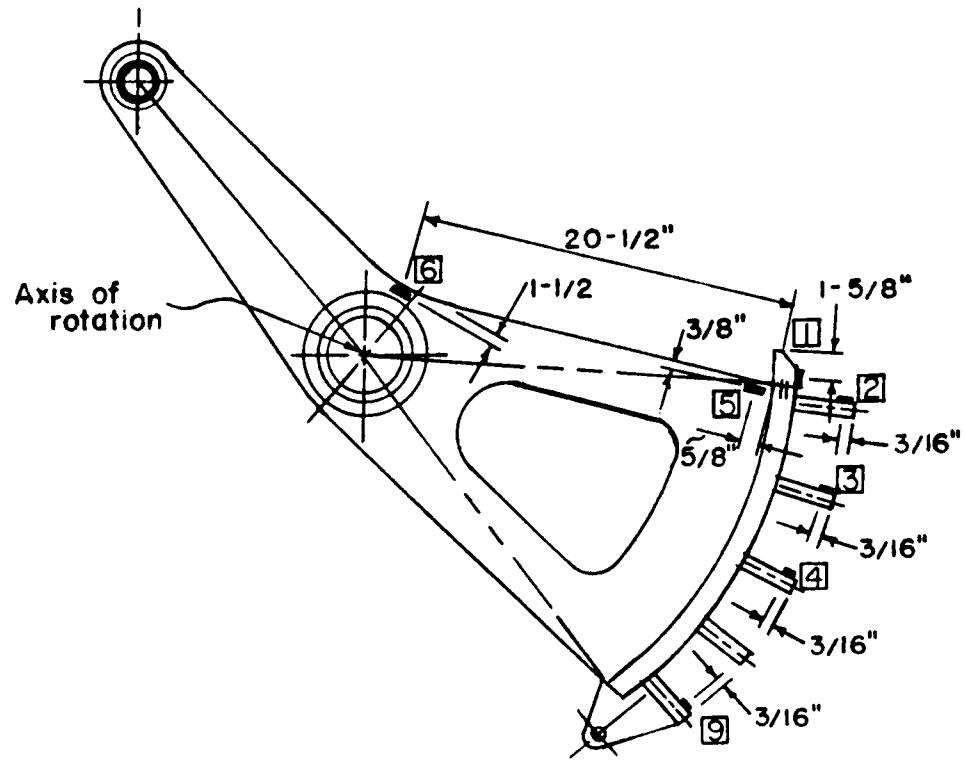


Figure 7. - Strain gauge locations. Gauge locations shown in boxes.

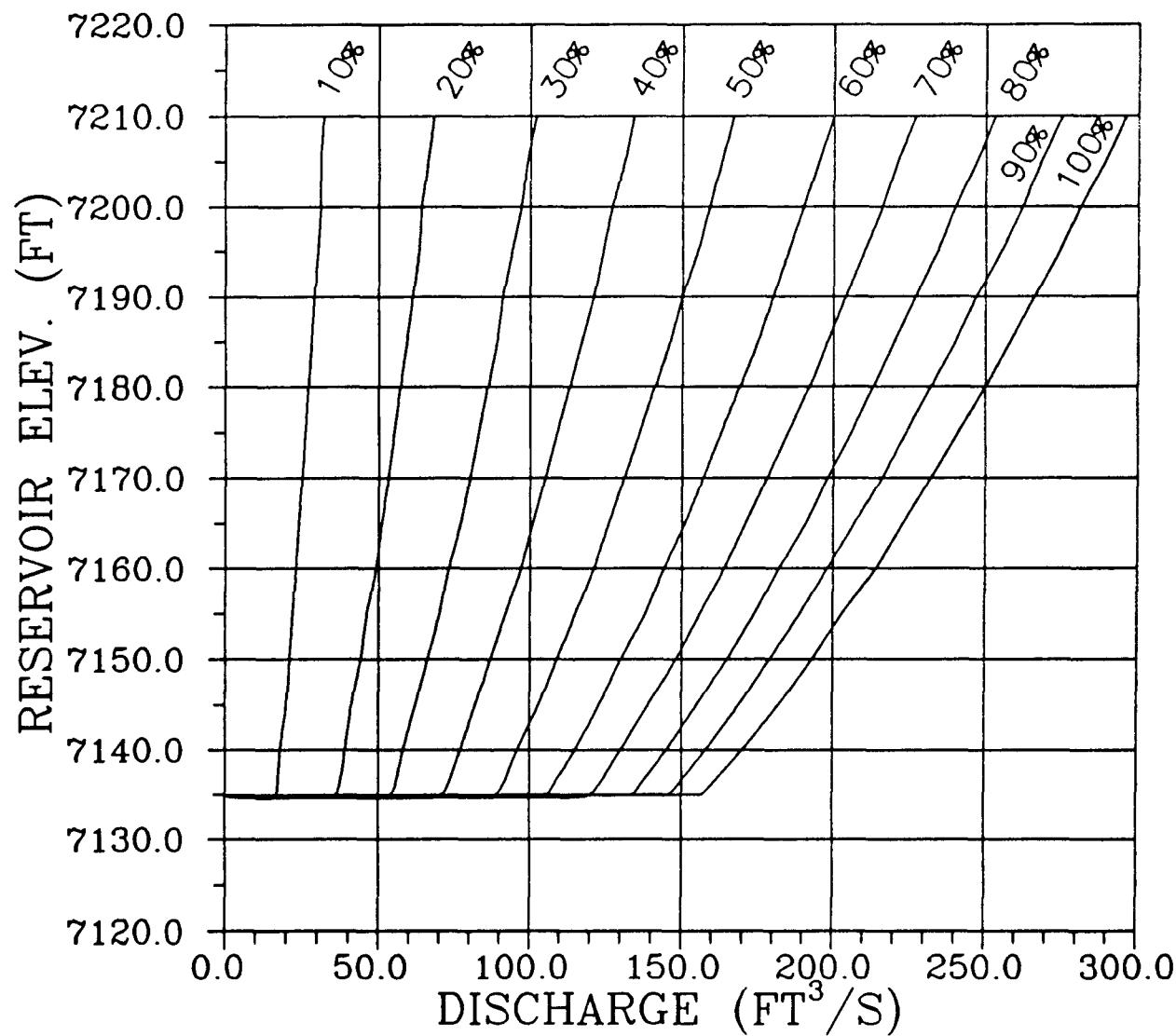


Figure 8. - Discharge curves for 30-inch clamshell gate at Grassy Lake Dam.

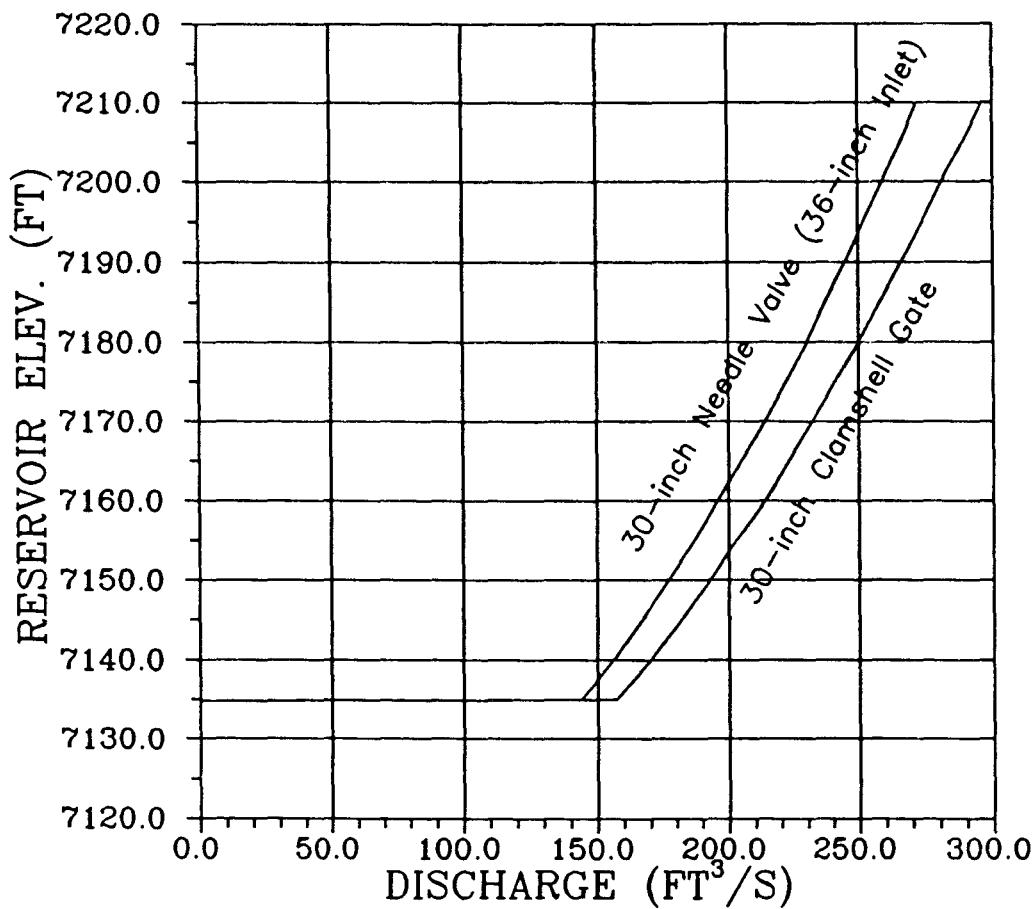


Figure 9. - Comparison of 30-inch needle valve and 30-inch clamshell gate.



## **APPENDIX**

**Discharge tables for 30-inch clamshell gate at Grassy Lake Dam**



GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)  
 MAX RESERVOIR ELEVATION: 7210.00000  
 MIN RESERVOIR ELEVATION: 7105.690000

RELATIVE HEAD LOSS AT INDIVIDUAL STRUCTURES  
 PERCENTAGE OF TOTAL SYSTEM LOSS

| STRUCTURE | GATE OPENING |     |     |     |     |     |     |     |     |      |
|-----------|--------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
|           | 10%          | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
| 1         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.   |
| 2         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.   |
| 3         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 1.   |
| 4         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.   |
| 5         | 0.           | 0.  | 1.  | 2.  | 3.  | 4.  | 5.  | 6.  | 7.  | 9.   |
| 6         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.   |
| 7         | 0.           | 0.  | 0.  | 0.  | 1.  | 1.  | 1.  | 1.  | 1.  | 2.   |
| 8         | 0.           | 0.  | 0.  | 0.  | 0.  | 1.  | 1.  | 1.  | 1.  | 1.   |
| 9         | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.   |
| 10        | 0.           | 2.  | 3.  | 6.  | 9.  | 13. | 17. | 21. | 25. | 29.  |
| 11        | 0.           | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 1.  | 1.  | 1.   |
| 12        | 0.           | 0.  | 0.  | 1.  | 1.  | 1.  | 2.  | 2.  | 2.  | 3.   |
| 13        | 99.          | 98. | 95. | 91. | 85. | 79. | 73. | 67. | 60. | 54.  |

DISCHARGE THRU SYSTEM

| RESLEVEL | GATE OPENING |     |      |      |      |      |      |      |      |      |
|----------|--------------|-----|------|------|------|------|------|------|------|------|
|          | 10%          | 20% | 30%  | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 10%      | 0.           | 0.  | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   |
| 20%      | 0.           | 0.  | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   |
| 30%      | 18.          | 37. | 56.  | 73.  | 92.  | 110. | 124. | 138. | 151. | 162. |
| 40%      | 20.          | 43. | 64.  | 85.  | 106. | 127. | 143. | 160. | 174. | 187. |
| 50%      | 23.          | 48. | 72.  | 95.  | 118. | 142. | 160. | 179. | 194. | 209. |
| 60%      | 25.          | 52. | 79.  | 104. | 130. | 155. | 176. | 196. | 213. | 229. |
| 70%      | 27.          | 57. | 85.  | 112. | 140. | 168. | 190. | 211. | 230. | 248. |
| 80%      | 29.          | 60. | 91.  | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 90%      | 30.          | 64. | 97.  | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 100%     | 32.          | 68. | 102. | 134. | 167. | 200. | 227. | 253. | 275. | 296. |

DISCHARGE THRU SYSTEM

| WATER SURFACE ELEVATION | GATE OPENING |     |      |      |      |      |      |      |      |      |
|-------------------------|--------------|-----|------|------|------|------|------|------|------|------|
|                         | 10%          | 20% | 30%  | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7116.12                 | 0.           | 0.  | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   |
| 7126.55                 | 0.           | 0.  | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   | 0.   |
| 7136.98                 | 18.          | 37. | 56.  | 73.  | 92.  | 110. | 124. | 138. | 151. | 162. |
| 7147.41                 | 20.          | 43. | 64.  | 85.  | 106. | 127. | 143. | 160. | 174. | 187. |
| 7157.84                 | 23.          | 48. | 72.  | 95.  | 118. | 142. | 160. | 179. | 194. | 209. |
| 7168.28                 | 25.          | 52. | 79.  | 104. | 130. | 155. | 176. | 196. | 213. | 229. |
| 7178.71                 | 27.          | 57. | 85.  | 112. | 140. | 168. | 190. | 211. | 230. | 248. |
| 7189.14                 | 29.          | 60. | 91.  | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 7199.57                 | 30.          | 64. | 97.  | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 7210.00                 | 32.          | 68. | 102. | 134. | 167. | 200. | 227. | 253. | 275. | 296. |

CORRELATIONS OF H-Q FOR EACH GATE OPENING

DISCHARGE=A\*(RESERVOIR ELEVATION-GATE CENTERLINE OR TAILWATER)\*\*B  
 (USE THE MAXIMUM AND MINIMUM ELEVATIONS)

| COEFFICIENTS | GATE OPENING |      |      |       |       |       |       |       |       |       |
|--------------|--------------|------|------|-------|-------|-------|-------|-------|-------|-------|
|              | 10%          | 20%  | 30%  | 40%   | 50%   | 60%   | 70%   | 80%   | 90%   | 100%  |
| A            | 3.14         | 6.61 | 9.96 | 13.11 | 16.36 | 19.58 | 22.19 | 24.70 | 26.89 | 28.92 |
| B            | .500         | .500 | .500 | .500  | .500  | .500  | .500  | .500  | .500  | .500  |
| R2           | 1.00         | 1.00 | 1.00 | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  | 1.00  |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
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 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)  
 MAX RESERVOIR ELEVATION: 7210.000000  
 MIN RESERVOIR ELEVATION: 7105.690000

| #  | J | I | K | STRUCTURE NAME       |                     |
|----|---|---|---|----------------------|---------------------|
| 1  | 1 | 5 | 0 | INTAKE STRUCTURE     | TRASHRACK           |
| 2  | 1 | 6 | 2 | INTAKE STRUCTURE     | SQUARE BELL         |
| 3  | 2 | 3 | 0 | CONVEYANCE STRUCTURE | ENTRANCE            |
| 4  | 2 | 1 | 5 | CONVEYANCE STRUCTURE | BEND                |
| 5  | 2 | 4 | 1 | SPECIAL CONTRACTION  | TRANSITION          |
| 6  | 2 | 3 | 0 | CIRCULAR             | CONDUIT             |
| 7  | 3 | 1 | 5 | CONVEYANCE STRUCTURE | BEND                |
| 8  | 3 | 2 | 0 | CONTROL STRUCTURE    | SPECIAL CONTRACTION |
| 9  | 3 | 1 | 6 | CONTROL STRUCTURE    | SLOT                |
| 10 | 2 | 4 | 1 | SPECIAL EXPANSION    | TRANSITION          |
| 11 | 3 | 1 | 1 | CONVEYANCE STRUCTURE | CONDUIT             |
| 12 | 3 | 1 | 1 | GRADUAL CONTR.       | TRANSITION          |
| 13 | 3 | 5 | 7 | GRADUAL CONTR.       | TRANSITION          |
|    |   |   |   | CLAMSHELL GATE       | BY T. ISBESTER      |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)  
 MAX RESERVOIR ELEVATION: 7210.000000  
 MIN RESERVOIR ELEVATION: 7105.690000

**Data File**  
 See Users Manual for Explanation of Format

|    |         |          |       |
|----|---------|----------|-------|
| 1  | 1       | 5        | 0     |
|    | 1.0000  | 125.0000 |       |
| 2  | 1       | 6        | 2     |
|    | 7.0000  | 5.0000   | .2000 |
| 3  | 2       | 3        | 0     |
|    | 19.6350 | .1700    |       |
| 4  | 2       | 1        | 5     |
|    | 19.6350 | 12.5660  | .1000 |
| 5  | 2       | 4        | 1     |
|    | 4.0000  | 243.5000 | .0000 |
| 6  | 2       | 3        | 0     |
|    | 12.5660 | .0450    |       |
| 7  | 3       | 1        | 5     |
|    | 12.5660 | 7.2500   | .1000 |
| 8  | 3       | 2        | 0     |
|    | 7.2500  | .0500    |       |
| 9  | 3       | 1        | 6     |
|    | 7.2500  | 8.2960   | .1500 |
| 10 | 2       | 4        | 1     |
|    | 3.2500  | 443.2000 | .0000 |
| 11 | 3       | 1        | 1     |
|    | 3.2500  | 3.0000   | .1000 |
| 12 | 3       | 1        | 1     |
|    | 3.0000  | 2.5000   | .1000 |
| 13 | 3       | 5        | 7     |
|    | 4.910   | 4.910    |       |

**Clamshell Coefficients**  
 .080 .170 .260 .350 .450 .560 .660 .770 .880 1.000

7210.00 7105.69 7135.00 .00 .00

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| WATER SURFACE ELEVATION | DISCHARGE THRU SYSTEM GATE OPENING |     |     |     |     |      |      |      |      |      |     |  |     |  |     |  |     |  |      |  |
|-------------------------|------------------------------------|-----|-----|-----|-----|------|------|------|------|------|-----|--|-----|--|-----|--|-----|--|------|--|
|                         | 10%                                |     | 20% |     | 30% |      | 40%  |      | 50%  |      | 60% |  | 70% |  | 80% |  | 90% |  | 100% |  |
|                         |                                    |     |     |     |     |      |      |      |      |      |     |  |     |  |     |  |     |  |      |  |
| 7135.00                 | 17.                                | 36. | 54. | 71. | 89. | 106. | 120. | 134. | 146. | 157. |     |  |     |  |     |  |     |  |      |  |
| 7135.10                 | 17.                                | 36. | 54. | 71. | 89. | 106. | 120. | 134. | 146. | 157. |     |  |     |  |     |  |     |  |      |  |
| 7135.20                 | 17.                                | 36. | 54. | 71. | 89. | 106. | 121. | 134. | 146. | 157. |     |  |     |  |     |  |     |  |      |  |
| 7135.30                 | 17.                                | 36. | 54. | 71. | 89. | 107. | 121. | 135. | 146. | 158. |     |  |     |  |     |  |     |  |      |  |
| 7135.40                 | 17.                                | 36. | 54. | 72. | 89. | 107. | 121. | 135. | 147. | 158. |     |  |     |  |     |  |     |  |      |  |
| 7135.50                 | 17.                                | 36. | 54. | 72. | 89. | 107. | 121. | 135. | 147. | 158. |     |  |     |  |     |  |     |  |      |  |
| 7135.60                 | 17.                                | 36. | 54. | 72. | 90. | 107. | 121. | 135. | 147. | 158. |     |  |     |  |     |  |     |  |      |  |
| 7135.70                 | 17.                                | 36. | 55. | 72. | 90. | 107. | 122. | 135. | 147. | 159. |     |  |     |  |     |  |     |  |      |  |
| 7135.80                 | 17.                                | 36. | 55. | 72. | 90. | 108. | 122. | 136. | 148. | 159. |     |  |     |  |     |  |     |  |      |  |
| 7135.90                 | 17.                                | 36. | 55. | 72. | 90. | 108. | 122. | 136. | 148. | 159. |     |  |     |  |     |  |     |  |      |  |
| 7136.00                 | 17.                                | 36. | 55. | 72. | 90. | 108. | 122. | 136. | 148. | 159. |     |  |     |  |     |  |     |  |      |  |
| 7136.10                 | 17.                                | 36. | 55. | 72. | 90. | 108. | 122. | 136. | 148. | 160. |     |  |     |  |     |  |     |  |      |  |
| 7136.20                 | 17.                                | 37. | 55. | 72. | 90. | 108. | 123. | 137. | 149. | 160. |     |  |     |  |     |  |     |  |      |  |
| 7136.30                 | 17.                                | 37. | 55. | 73. | 91. | 108. | 123. | 137. | 149. | 160. |     |  |     |  |     |  |     |  |      |  |
| 7136.40                 | 17.                                | 37. | 55. | 73. | 91. | 109. | 123. | 137. | 149. | 161. |     |  |     |  |     |  |     |  |      |  |
| 7136.50                 | 17.                                | 37. | 55. | 73. | 91. | 109. | 123. | 137. | 149. | 161. |     |  |     |  |     |  |     |  |      |  |
| 7136.60                 | 17.                                | 37. | 55. | 73. | 91. | 109. | 123. | 138. | 150. | 161. |     |  |     |  |     |  |     |  |      |  |
| 7136.70                 | 18.                                | 37. | 55. | 73. | 91. | 109. | 124. | 138. | 150. | 161. |     |  |     |  |     |  |     |  |      |  |
| 7136.80                 | 18.                                | 37. | 56. | 73. | 91. | 109. | 124. | 138. | 150. | 162. |     |  |     |  |     |  |     |  |      |  |
| 7136.90                 | 18.                                | 37. | 56. | 73. | 91. | 110. | 124. | 138. | 150. | 162. |     |  |     |  |     |  |     |  |      |  |
| 7137.00                 | 18.                                | 37. | 56. | 73. | 92. | 110. | 124. | 138. | 151. | 162. |     |  |     |  |     |  |     |  |      |  |
| 7137.10                 | 18.                                | 37. | 56. | 74. | 92. | 110. | 124. | 139. | 151. | 162. |     |  |     |  |     |  |     |  |      |  |
| 7137.20                 | 18.                                | 37. | 56. | 74. | 92. | 110. | 125. | 139. | 151. | 163. |     |  |     |  |     |  |     |  |      |  |
| 7137.30                 | 18.                                | 37. | 56. | 74. | 92. | 110. | 125. | 139. | 151. | 163. |     |  |     |  |     |  |     |  |      |  |
| 7137.40                 | 18.                                | 37. | 56. | 74. | 92. | 110. | 125. | 139. | 152. | 163. |     |  |     |  |     |  |     |  |      |  |
| 7137.50                 | 18.                                | 37. | 56. | 74. | 92. | 111. | 125. | 140. | 152. | 163. |     |  |     |  |     |  |     |  |      |  |
| 7137.60                 | 18.                                | 37. | 56. | 74. | 92. | 111. | 125. | 140. | 152. | 164. |     |  |     |  |     |  |     |  |      |  |
| 7137.70                 | 18.                                | 37. | 56. | 74. | 93. | 111. | 126. | 140. | 152. | 164. |     |  |     |  |     |  |     |  |      |  |
| 7137.80                 | 18.                                | 37. | 56. | 74. | 93. | 111. | 126. | 140. | 153. | 164. |     |  |     |  |     |  |     |  |      |  |
| 7137.90                 | 18.                                | 38. | 57. | 74. | 93. | 111. | 126. | 140. | 153. | 164. |     |  |     |  |     |  |     |  |      |  |
| 7138.00                 | 18.                                | 38. | 57. | 75. | 93. | 111. | 126. | 141. | 153. | 165. |     |  |     |  |     |  |     |  |      |  |
| 7138.10                 | 18.                                | 38. | 57. | 75. | 93. | 112. | 126. | 141. | 153. | 165. |     |  |     |  |     |  |     |  |      |  |
| 7138.20                 | 18.                                | 38. | 57. | 75. | 93. | 112. | 127. | 141. | 154. | 165. |     |  |     |  |     |  |     |  |      |  |
| 7138.30                 | 18.                                | 38. | 57. | 75. | 94. | 112. | 127. | 141. | 154. | 165. |     |  |     |  |     |  |     |  |      |  |
| 7138.40                 | 18.                                | 38. | 57. | 75. | 94. | 112. | 127. | 141. | 154. | 166. |     |  |     |  |     |  |     |  |      |  |
| 7138.50                 | 18.                                | 38. | 57. | 75. | 94. | 112. | 127. | 142. | 154. | 166. |     |  |     |  |     |  |     |  |      |  |
| 7138.60                 | 18.                                | 38. | 57. | 75. | 94. | 112. | 127. | 142. | 154. | 166. |     |  |     |  |     |  |     |  |      |  |
| 7138.70                 | 18.                                | 38. | 57. | 75. | 94. | 113. | 128. | 142. | 155. | 166. |     |  |     |  |     |  |     |  |      |  |
| 7138.80                 | 18.                                | 38. | 57. | 76. | 94. | 113. | 128. | 142. | 155. | 167. |     |  |     |  |     |  |     |  |      |  |
| 7138.90                 | 18.                                | 38. | 57. | 76. | 94. | 113. | 128. | 143. | 155. | 167. |     |  |     |  |     |  |     |  |      |  |
| 7139.00                 | 18.                                | 38. | 57. | 76. | 94. | 113. | 128. | 143. | 155. | 167. |     |  |     |  |     |  |     |  |      |  |
| 7139.10                 | 18.                                | 38. | 58. | 76. | 95. | 113. | 128. | 143. | 156. | 167. |     |  |     |  |     |  |     |  |      |  |
| 7139.20                 | 18.                                | 38. | 58. | 76. | 95. | 113. | 129. | 143. | 156. | 168. |     |  |     |  |     |  |     |  |      |  |
| 7139.30                 | 18.                                | 38. | 58. | 76. | 95. | 114. | 129. | 143. | 156. | 168. |     |  |     |  |     |  |     |  |      |  |
| 7139.40                 | 18.                                | 38. | 58. | 76. | 95. | 114. | 129. | 144. | 156. | 168. |     |  |     |  |     |  |     |  |      |  |
| 7139.50                 | 18.                                | 38. | 58. | 76. | 95. | 114. | 129. | 144. | 157. | 168. |     |  |     |  |     |  |     |  |      |  |
| 7139.60                 | 18.                                | 39. | 58. | 76. | 95. | 114. | 129. | 144. | 157. | 169. |     |  |     |  |     |  |     |  |      |  |
| 7139.70                 | 18.                                | 39. | 58. | 77. | 95. | 114. | 130. | 144. | 157. | 169. |     |  |     |  |     |  |     |  |      |  |
| 7139.80                 | 18.                                | 39. | 58. | 77. | 96. | 114. | 130. | 144. | 157. | 169. |     |  |     |  |     |  |     |  |      |  |
| 7139.90                 | 18.                                | 39. | 58. | 77. | 96. | 115. | 130. | 145. | 157. | 169. |     |  |     |  |     |  |     |  |      |  |
| 7140.00                 | 18.                                | 39. | 58. | 77. | 96. | 115. | 130. | 145. | 158. | 170. |     |  |     |  |     |  |     |  |      |  |
| 7140.10                 | 18.                                | 39. | 58. | 77. | 96. | 115. | 130. | 145. | 158. | 170. |     |  |     |  |     |  |     |  |      |  |
| 7140.20                 | 18.                                | 39. | 59. | 77. | 96. | 115. | 130. | 145. | 158. | 170. |     |  |     |  |     |  |     |  |      |  |
| 7140.30                 | 18.                                | 39. | 59. | 77. | 96. | 115. | 131. | 146. | 158. | 170. |     |  |     |  |     |  |     |  |      |  |
| 7140.40                 | 19.                                | 39. | 59. | 77. | 96. | 115. | 131. | 146. | 159. | 171. |     |  |     |  |     |  |     |  |      |  |
| 7140.50                 | 19.                                | 39. | 59. | 77. | 97. | 116. | 131. | 146. | 159. | 171. |     |  |     |  |     |  |     |  |      |  |
| 7140.60                 | 19.                                | 39. | 59. | 78. | 97. | 116. | 131. | 146. | 159. | 171. |     |  |     |  |     |  |     |  |      |  |
| 7140.70                 | 19.                                | 39. | 59. | 78. | 97. | 116. | 131. | 146. | 159. | 171. |     |  |     |  |     |  |     |  |      |  |
| 7140.80                 | 19.                                | 39. | 59. | 78. | 97. | 116. | 132. | 147. | 160. | 172. |     |  |     |  |     |  |     |  |      |  |
| 7140.90                 | 19.                                | 39. | 59. | 78. | 97. | 116. | 132. | 147. | 160. | 172. |     |  |     |  |     |  |     |  |      |  |
| 7141.00                 | 19.                                | 39. | 59. | 78. | 97. | 116. | 132. | 147. | 160. | 172. |     |  |     |  |     |  |     |  |      |  |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| DISCHARGE THRU SYSTEM   |              |     |     |     |      |      |      |      |      |      |
|-------------------------|--------------|-----|-----|-----|------|------|------|------|------|------|
| WATER SURFACE ELEVATION | GATE OPENING |     |     |     |      |      |      |      |      |      |
|                         | 10%          | 20% | 30% | 40% | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7141.10                 | 19.          | 39. | 59. | 78. | 97.  | 117. | 132. | 147. | 160. | 172. |
| 7141.20                 | 19.          | 39. | 59. | 78. | 98.  | 117. | 132. | 147. | 160. | 173. |
| 7141.30                 | 19.          | 39. | 59. | 78. | 98.  | 117. | 133. | 148. | 161. | 173. |
| 7141.40                 | 19.          | 40. | 60. | 78. | 98.  | 117. | 133. | 148. | 161. | 173. |
| 7141.50                 | 19.          | 40. | 60. | 79. | 98.  | 117. | 133. | 148. | 161. | 173. |
| 7141.60                 | 19.          | 40. | 60. | 79. | 98.  | 117. | 133. | 148. | 161. | 174. |
| 7141.70                 | 19.          | 40. | 60. | 79. | 98.  | 118. | 133. | 148. | 162. | 174. |
| 7141.80                 | 19.          | 40. | 60. | 79. | 98.  | 118. | 133. | 149. | 162. | 174. |
| 7141.90                 | 19.          | 40. | 60. | 79. | 99.  | 118. | 134. | 149. | 162. | 174. |
| 7142.00                 | 19.          | 40. | 60. | 79. | 99.  | 118. | 134. | 149. | 162. | 175. |
| 7142.10                 | 19.          | 40. | 60. | 79. | 99.  | 118. | 134. | 149. | 162. | 175. |
| 7142.20                 | 19.          | 40. | 60. | 79. | 99.  | 118. | 134. | 149. | 163. | 175. |
| 7142.30                 | 19.          | 40. | 60. | 79. | 99.  | 119. | 134. | 150. | 163. | 175. |
| 7142.40                 | 19.          | 40. | 60. | 80. | 99.  | 119. | 135. | 150. | 163. | 176. |
| 7142.50                 | 19.          | 40. | 60. | 80. | 99.  | 119. | 135. | 150. | 163. | 176. |
| 7142.60                 | 19.          | 40. | 61. | 80. | 99.  | 119. | 135. | 150. | 164. | 176. |
| 7142.70                 | 19.          | 40. | 61. | 80. | 100. | 119. | 135. | 150. | 164. | 176. |
| 7142.80                 | 19.          | 40. | 61. | 80. | 100. | 119. | 135. | 151. | 164. | 176. |
| 7142.90                 | 19.          | 40. | 61. | 80. | 100. | 120. | 135. | 151. | 164. | 177. |
| 7143.00                 | 19.          | 40. | 61. | 80. | 100. | 120. | 136. | 151. | 164. | 177. |
| 7143.10                 | 19.          | 40. | 61. | 80. | 100. | 120. | 136. | 151. | 165. | 177. |
| 7143.20                 | 19.          | 41. | 61. | 80. | 100. | 120. | 136. | 151. | 165. | 177. |
| 7143.30                 | 19.          | 41. | 61. | 80. | 100. | 120. | 136. | 152. | 165. | 178. |
| 7143.40                 | 19.          | 41. | 61. | 81. | 101. | 120. | 136. | 152. | 165. | 178. |
| 7143.50                 | 19.          | 41. | 61. | 81. | 101. | 121. | 137. | 152. | 166. | 178. |
| 7143.60                 | 19.          | 41. | 61. | 81. | 101. | 121. | 137. | 152. | 166. | 178. |
| 7143.70                 | 19.          | 41. | 61. | 81. | 101. | 121. | 137. | 153. | 166. | 179. |
| 7143.80                 | 19.          | 41. | 61. | 81. | 101. | 121. | 137. | 153. | 166. | 179. |
| 7143.90                 | 19.          | 41. | 62. | 81. | 101. | 121. | 137. | 153. | 166. | 179. |
| 7144.00                 | 19.          | 41. | 62. | 81. | 101. | 121. | 137. | 153. | 167. | 179. |
| 7144.10                 | 19.          | 41. | 62. | 81. | 101. | 121. | 138. | 153. | 167. | 180. |
| 7144.20                 | 20.          | 41. | 62. | 81. | 102. | 122. | 138. | 154. | 167. | 180. |
| 7144.30                 | 20.          | 41. | 62. | 82. | 102. | 122. | 138. | 154. | 167. | 180. |
| 7144.40                 | 20.          | 41. | 62. | 82. | 102. | 122. | 138. | 154. | 168. | 180. |
| 7144.50                 | 20.          | 41. | 62. | 82. | 102. | 122. | 138. | 154. | 168. | 180. |
| 7144.60                 | 20.          | 41. | 62. | 82. | 102. | 122. | 139. | 154. | 168. | 181. |
| 7144.70                 | 20.          | 41. | 62. | 82. | 102. | 122. | 139. | 154. | 168. | 181. |
| 7144.80                 | 20.          | 41. | 62. | 82. | 102. | 123. | 139. | 155. | 168. | 181. |
| 7144.90                 | 20.          | 41. | 62. | 82. | 103. | 123. | 139. | 155. | 169. | 181. |
| 7145.00                 | 20.          | 41. | 62. | 82. | 103. | 123. | 139. | 155. | 169. | 182. |
| 7145.10                 | 20.          | 42. | 63. | 82. | 103. | 123. | 139. | 155. | 169. | 182. |
| 7145.20                 | 20.          | 42. | 63. | 82. | 103. | 123. | 140. | 155. | 169. | 182. |
| 7145.30                 | 20.          | 42. | 63. | 83. | 103. | 123. | 140. | 156. | 169. | 182. |
| 7145.40                 | 20.          | 42. | 63. | 83. | 103. | 124. | 140. | 156. | 170. | 183. |
| 7145.50                 | 20.          | 42. | 63. | 83. | 103. | 124. | 140. | 156. | 170. | 183. |
| 7145.60                 | 20.          | 42. | 63. | 83. | 103. | 124. | 140. | 156. | 170. | 183. |
| 7145.70                 | 20.          | 42. | 63. | 83. | 104. | 124. | 141. | 156. | 170. | 183. |
| 7145.80                 | 20.          | 42. | 63. | 83. | 104. | 124. | 141. | 157. | 171. | 183. |
| 7145.90                 | 20.          | 42. | 63. | 83. | 104. | 124. | 141. | 157. | 171. | 184. |
| 7146.00                 | 20.          | 42. | 63. | 83. | 104. | 124. | 141. | 157. | 171. | 184. |
| 7146.10                 | 20.          | 42. | 63. | 83. | 104. | 125. | 141. | 157. | 171. | 184. |
| 7146.20                 | 20.          | 42. | 63. | 84. | 104. | 125. | 141. | 157. | 171. | 184. |
| 7146.30                 | 20.          | 42. | 63. | 84. | 104. | 125. | 142. | 158. | 172. | 185. |
| 7146.40                 | 20.          | 42. | 64. | 84. | 104. | 125. | 142. | 158. | 172. | 185. |
| 7146.50                 | 20.          | 42. | 64. | 84. | 105. | 125. | 142. | 158. | 172. | 185. |
| 7146.60                 | 20.          | 42. | 64. | 84. | 105. | 125. | 142. | 158. | 172. | 185. |
| 7146.70                 | 20.          | 42. | 64. | 84. | 105. | 126. | 142. | 158. | 172. | 186. |
| 7146.80                 | 20.          | 42. | 64. | 84. | 105. | 126. | 142. | 159. | 173. | 186. |
| 7146.90                 | 20.          | 42. | 64. | 84. | 105. | 126. | 143. | 159. | 173. | 186. |
| 7147.00                 | 20.          | 43. | 64. | 84. | 105. | 126. | 143. | 159. | 173. | 186. |
| 7147.10                 | 20.          | 43. | 64. | 84. | 105. | 126. | 143. | 159. | 173. | 186. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| ELEVATION | GATE OPENING |     |     |     |      |      |      |      |      |      |
|-----------|--------------|-----|-----|-----|------|------|------|------|------|------|
|           | 10%          | 20% | 30% | 40% | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7147.20   | 20.          | 43. | 64. | 85. | 105. | 126. | 143. | 159. | 173. | 187. |
| 7147.30   | 20.          | 43. | 64. | 85. | 106. | 126. | 143. | 160. | 174. | 187. |
| 7147.40   | 20.          | 43. | 64. | 85. | 106. | 127. | 143. | 160. | 174. | 187. |
| 7147.50   | 20.          | 43. | 64. | 85. | 106. | 127. | 144. | 160. | 174. | 187. |
| 7147.60   | 20.          | 43. | 64. | 85. | 106. | 127. | 144. | 160. | 174. | 188. |
| 7147.70   | 20.          | 43. | 65. | 85. | 106. | 127. | 144. | 160. | 175. | 188. |
| 7147.80   | 20.          | 43. | 65. | 85. | 106. | 127. | 144. | 161. | 175. | 188. |
| 7147.90   | 20.          | 43. | 65. | 85. | 106. | 127. | 144. | 161. | 175. | 188. |
| 7148.00   | 20.          | 43. | 65. | 85. | 107. | 128. | 144. | 161. | 175. | 188. |
| 7148.10   | 20.          | 43. | 65. | 85. | 107. | 128. | 145. | 161. | 175. | 189. |
| 7148.20   | 20.          | 43. | 65. | 86. | 107. | 128. | 145. | 161. | 176. | 189. |
| 7148.30   | 21.          | 43. | 65. | 86. | 107. | 128. | 145. | 161. | 176. | 189. |
| 7148.40   | 21.          | 43. | 65. | 86. | 107. | 128. | 145. | 162. | 176. | 189. |
| 7148.50   | 21.          | 43. | 65. | 86. | 107. | 128. | 145. | 162. | 176. | 190. |
| 7148.60   | 21.          | 43. | 65. | 86. | 107. | 128. | 146. | 162. | 176. | 190. |
| 7148.70   | 21.          | 43. | 65. | 86. | 107. | 129. | 146. | 162. | 177. | 190. |
| 7148.80   | 21.          | 43. | 65. | 86. | 108. | 129. | 146. | 162. | 177. | 190. |
| 7148.90   | 21.          | 43. | 65. | 86. | 108. | 129. | 146. | 163. | 177. | 190. |
| 7149.00   | 21.          | 44. | 66. | 86. | 108. | 129. | 146. | 163. | 177. | 191. |
| 7149.10   | 21.          | 44. | 66. | 86. | 108. | 129. | 146. | 163. | 177. | 191. |
| 7149.20   | 21.          | 44. | 66. | 87. | 108. | 129. | 147. | 163. | 178. | 191. |
| 7149.30   | 21.          | 44. | 66. | 87. | 108. | 129. | 147. | 163. | 178. | 191. |
| 7149.40   | 21.          | 44. | 66. | 87. | 108. | 130. | 147. | 164. | 178. | 192. |
| 7149.50   | 21.          | 44. | 66. | 87. | 108. | 130. | 147. | 164. | 178. | 192. |
| 7149.60   | 21.          | 44. | 66. | 87. | 109. | 130. | 147. | 164. | 178. | 192. |
| 7149.70   | 21.          | 44. | 66. | 87. | 109. | 130. | 147. | 164. | 179. | 192. |
| 7149.80   | 21.          | 44. | 66. | 87. | 109. | 130. | 148. | 164. | 179. | 192. |
| 7149.90   | 21.          | 44. | 66. | 87. | 109. | 130. | 148. | 164. | 179. | 193. |
| 7150.00   | 21.          | 44. | 66. | 87. | 109. | 130. | 148. | 165. | 179. | 193. |
| 7150.10   | 21.          | 44. | 66. | 87. | 109. | 131. | 148. | 165. | 179. | 193. |
| 7150.20   | 21.          | 44. | 66. | 88. | 109. | 131. | 148. | 165. | 180. | 193. |
| 7150.30   | 21.          | 44. | 67. | 88. | 109. | 131. | 148. | 165. | 180. | 193. |
| 7150.40   | 21.          | 44. | 67. | 88. | 109. | 131. | 149. | 165. | 180. | 194. |
| 7150.50   | 21.          | 44. | 67. | 88. | 109. | 131. | 149. | 166. | 180. | 194. |
| 7150.60   | 21.          | 44. | 67. | 88. | 110. | 131. | 149. | 166. | 180. | 194. |
| 7150.70   | 21.          | 44. | 67. | 88. | 110. | 132. | 149. | 166. | 181. | 194. |
| 7150.80   | 21.          | 44. | 67. | 88. | 110. | 132. | 149. | 166. | 181. | 195. |
| 7150.90   | 21.          | 44. | 67. | 88. | 110. | 132. | 149. | 166. | 181. | 195. |
| 7151.00   | 21.          | 45. | 67. | 88. | 110. | 132. | 150. | 167. | 181. | 195. |
| 7151.10   | 21.          | 45. | 67. | 88. | 110. | 132. | 150. | 167. | 181. | 195. |
| 7151.20   | 21.          | 45. | 67. | 89. | 110. | 132. | 150. | 167. | 182. | 195. |
| 7151.30   | 21.          | 45. | 67. | 89. | 111. | 132. | 150. | 167. | 182. | 196. |
| 7151.40   | 21.          | 45. | 67. | 89. | 111. | 133. | 150. | 167. | 182. | 196. |
| 7151.50   | 21.          | 45. | 67. | 89. | 111. | 133. | 150. | 167. | 182. | 196. |
| 7151.60   | 21.          | 45. | 67. | 89. | 111. | 133. | 151. | 168. | 182. | 196. |
| 7151.70   | 21.          | 45. | 68. | 89. | 111. | 133. | 151. | 168. | 183. | 197. |
| 7151.80   | 21.          | 45. | 68. | 89. | 111. | 133. | 151. | 168. | 183. | 197. |
| 7151.90   | 21.          | 45. | 68. | 89. | 111. | 133. | 151. | 168. | 183. | 197. |
| 7152.00   | 21.          | 45. | 68. | 89. | 111. | 133. | 151. | 168. | 183. | 197. |
| 7152.10   | 21.          | 45. | 68. | 89. | 112. | 134. | 151. | 169. | 183. | 197. |
| 7152.20   | 21.          | 45. | 68. | 89. | 112. | 134. | 151. | 169. | 184. | 198. |
| 7152.30   | 21.          | 45. | 68. | 90. | 112. | 134. | 152. | 169. | 184. | 198. |
| 7152.40   | 21.          | 45. | 68. | 90. | 112. | 134. | 152. | 169. | 184. | 198. |
| 7152.50   | 22.          | 45. | 68. | 90. | 112. | 134. | 152. | 169. | 184. | 198. |
| 7152.60   | 22.          | 45. | 68. | 90. | 112. | 134. | 152. | 169. | 184. | 198. |
| 7152.70   | 22.          | 45. | 68. | 90. | 112. | 134. | 152. | 170. | 185. | 199. |
| 7152.80   | 22.          | 45. | 68. | 90. | 112. | 135. | 152. | 170. | 185. | 199. |
| 7152.90   | 22.          | 45. | 68. | 90. | 113. | 135. | 153. | 170. | 185. | 199. |
| 7153.00   | 22.          | 46. | 69. | 90. | 113. | 135. | 153. | 170. | 185. | 199. |
| 7153.10   | 22.          | 46. | 69. | 90. | 113. | 135. | 153. | 170. | 185. | 199. |
| 7153.20   | 22.          | 46. | 69. | 90. | 113. | 135. | 153. | 171. | 186. | 200. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| DISCHARGE THRU SYSTEM   |              |     |     |     |      |      |      |      |      |      |
|-------------------------|--------------|-----|-----|-----|------|------|------|------|------|------|
| WATER SURFACE ELEVATION | GATE OPENING |     |     |     |      |      |      |      |      |      |
|                         | 10%          | 20% | 30% | 40% | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7153.30                 | 22.          | 46. | 69. | 91. | 113. | 135. | 153. | 171. | 186. | 200. |
| 7153.40                 | 22.          | 46. | 69. | 91. | 113. | 135. | 153. | 171. | 186. | 200. |
| 7153.50                 | 22.          | 46. | 69. | 91. | 113. | 136. | 154. | 171. | 186. | 200. |
| 7153.60                 | 22.          | 46. | 69. | 91. | 113. | 136. | 154. | 171. | 186. | 201. |
| 7153.70                 | 22.          | 46. | 69. | 91. | 113. | 136. | 154. | 171. | 187. | 201. |
| 7153.80                 | 22.          | 46. | 69. | 91. | 114. | 136. | 154. | 172. | 187. | 201. |
| 7153.90                 | 22.          | 46. | 69. | 91. | 114. | 136. | 154. | 172. | 187. | 201. |
| 7154.00                 | 22.          | 46. | 69. | 91. | 114. | 136. | 154. | 172. | 187. | 201. |
| 7154.10                 | 22.          | 46. | 69. | 91. | 114. | 136. | 155. | 172. | 187. | 202. |
| 7154.20                 | 22.          | 46. | 69. | 91. | 114. | 137. | 155. | 172. | 188. | 202. |
| 7154.30                 | 22.          | 46. | 69. | 91. | 114. | 137. | 155. | 172. | 188. | 202. |
| 7154.40                 | 22.          | 46. | 70. | 92. | 114. | 137. | 155. | 173. | 188. | 202. |
| 7154.50                 | 22.          | 46. | 70. | 92. | 114. | 137. | 155. | 173. | 188. | 202. |
| 7154.60                 | 22.          | 46. | 70. | 92. | 115. | 137. | 155. | 173. | 188. | 203. |
| 7154.70                 | 22.          | 46. | 70. | 92. | 115. | 137. | 156. | 173. | 189. | 203. |
| 7154.80                 | 22.          | 46. | 70. | 92. | 115. | 137. | 156. | 173. | 189. | 203. |
| 7154.90                 | 22.          | 46. | 70. | 92. | 115. | 138. | 156. | 174. | 189. | 203. |
| 7155.00                 | 22.          | 46. | 70. | 92. | 115. | 138. | 156. | 174. | 189. | 203. |
| 7155.10                 | 22.          | 47. | 70. | 92. | 115. | 138. | 156. | 174. | 189. | 204. |
| 7155.20                 | 22.          | 47. | 70. | 92. | 115. | 138. | 156. | 174. | 189. | 204. |
| 7155.30                 | 22.          | 47. | 70. | 92. | 115. | 138. | 156. | 174. | 190. | 204. |
| 7155.40                 | 22.          | 47. | 70. | 93. | 115. | 138. | 157. | 174. | 190. | 204. |
| 7155.50                 | 22.          | 47. | 70. | 93. | 116. | 138. | 157. | 175. | 190. | 204. |
| 7155.60                 | 22.          | 47. | 70. | 93. | 116. | 138. | 157. | 175. | 190. | 205. |
| 7155.70                 | 22.          | 47. | 70. | 93. | 116. | 139. | 157. | 175. | 190. | 205. |
| 7155.80                 | 22.          | 47. | 71. | 93. | 116. | 139. | 157. | 175. | 191. | 205. |
| 7155.90                 | 22.          | 47. | 71. | 93. | 116. | 139. | 157. | 175. | 191. | 205. |
| 7156.00                 | 22.          | 47. | 71. | 93. | 116. | 139. | 158. | 175. | 191. | 205. |
| 7156.10                 | 22.          | 47. | 71. | 93. | 116. | 139. | 158. | 176. | 191. | 206. |
| 7156.20                 | 22.          | 47. | 71. | 93. | 116. | 139. | 158. | 176. | 191. | 206. |
| 7156.30                 | 22.          | 47. | 71. | 93. | 116. | 139. | 158. | 176. | 192. | 206. |
| 7156.40                 | 22.          | 47. | 71. | 93. | 117. | 140. | 158. | 176. | 192. | 206. |
| 7156.50                 | 22.          | 47. | 71. | 94. | 117. | 140. | 158. | 176. | 192. | 207. |
| 7156.60                 | 22.          | 47. | 71. | 94. | 117. | 140. | 159. | 177. | 192. | 207. |
| 7156.70                 | 22.          | 47. | 71. | 94. | 117. | 140. | 159. | 177. | 192. | 207. |
| 7156.80                 | 22.          | 47. | 71. | 94. | 117. | 140. | 159. | 177. | 193. | 207. |
| 7156.90                 | 22.          | 47. | 71. | 94. | 117. | 140. | 159. | 177. | 193. | 207. |
| 7157.00                 | 23.          | 47. | 71. | 94. | 117. | 140. | 159. | 177. | 193. | 208. |
| 7157.10                 | 23.          | 47. | 71. | 94. | 117. | 141. | 159. | 177. | 193. | 208. |
| 7157.20                 | 23.          | 47. | 71. | 94. | 118. | 141. | 159. | 178. | 193. | 208. |
| 7157.30                 | 23.          | 48. | 72. | 94. | 118. | 141. | 160. | 178. | 193. | 208. |
| 7157.40                 | 23.          | 48. | 72. | 94. | 118. | 141. | 160. | 178. | 194. | 208. |
| 7157.50                 | 23.          | 48. | 72. | 94. | 118. | 141. | 160. | 178. | 194. | 209. |
| 7157.60                 | 23.          | 48. | 72. | 95. | 118. | 141. | 160. | 178. | 194. | 209. |
| 7157.70                 | 23.          | 48. | 72. | 95. | 118. | 141. | 160. | 178. | 194. | 209. |
| 7157.80                 | 23.          | 48. | 72. | 95. | 118. | 142. | 160. | 179. | 194. | 209. |
| 7157.90                 | 23.          | 48. | 72. | 95. | 118. | 142. | 161. | 179. | 195. | 209. |
| 7158.00                 | 23.          | 48. | 72. | 95. | 118. | 142. | 161. | 179. | 195. | 210. |
| 7158.10                 | 23.          | 48. | 72. | 95. | 119. | 142. | 161. | 179. | 195. | 210. |
| 7158.20                 | 23.          | 48. | 72. | 95. | 119. | 142. | 161. | 179. | 195. | 210. |
| 7158.30                 | 23.          | 48. | 72. | 95. | 119. | 142. | 161. | 179. | 195. | 210. |
| 7158.40                 | 23.          | 48. | 72. | 95. | 119. | 142. | 161. | 180. | 195. | 210. |
| 7158.50                 | 23.          | 48. | 72. | 95. | 119. | 142. | 161. | 180. | 196. | 211. |
| 7158.60                 | 23.          | 48. | 72. | 95. | 119. | 143. | 162. | 180. | 196. | 211. |
| 7158.70                 | 23.          | 48. | 73. | 96. | 119. | 143. | 162. | 180. | 196. | 211. |
| 7158.80                 | 23.          | 48. | 73. | 96. | 119. | 143. | 162. | 180. | 196. | 211. |
| 7158.90                 | 23.          | 48. | 73. | 96. | 119. | 143. | 162. | 180. | 196. | 211. |
| 7159.00                 | 23.          | 48. | 73. | 96. | 120. | 143. | 162. | 181. | 197. | 212. |
| 7159.10                 | 23.          | 48. | 73. | 96. | 120. | 143. | 162. | 181. | 197. | 212. |
| 7159.20                 | 23.          | 48. | 73. | 96. | 120. | 143. | 163. | 181. | 197. | 212. |
| 7159.30                 | 23.          | 48. | 73. | 96. | 120. | 144. | 163. | 181. | 197. | 212. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| WATER SURFACE ELEVATION | DISCHARGE THRU SYSTEM GATE OPENING |     |     |      |      |      |      |      |      |      |
|-------------------------|------------------------------------|-----|-----|------|------|------|------|------|------|------|
|                         | 10%                                | 20% | 30% | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7159.40                 | 23.                                | 48. | 73. | 96.  | 120. | 144. | 163. | 181. | 197. | 212. |
| 7159.50                 | 23.                                | 49. | 73. | 96.  | 120. | 144. | 163. | 181. | 198. | 213. |
| 7159.60                 | 23.                                | 49. | 73. | 96.  | 120. | 144. | 163. | 182. | 198. | 213. |
| 7159.70                 | 23.                                | 49. | 73. | 96.  | 120. | 144. | 163. | 182. | 198. | 213. |
| 7159.80                 | 23.                                | 49. | 73. | 97.  | 120. | 144. | 163. | 182. | 198. | 213. |
| 7159.90                 | 23.                                | 49. | 73. | 97.  | 121. | 144. | 164. | 182. | 198. | 213. |
| 7160.00                 | 23.                                | 49. | 73. | 97.  | 121. | 144. | 164. | 182. | 198. | 214. |
| 7160.10                 | 23.                                | 49. | 73. | 97.  | 121. | 145. | 164. | 182. | 199. | 214. |
| 7160.20                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 164. | 183. | 199. | 214. |
| 7160.30                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 164. | 183. | 199. | 214. |
| 7160.40                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 164. | 183. | 199. | 214. |
| 7160.50                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 164. | 183. | 199. | 214. |
| 7160.60                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 165. | 183. | 200. | 215. |
| 7160.70                 | 23.                                | 49. | 74. | 97.  | 121. | 145. | 165. | 183. | 200. | 215. |
| 7160.80                 | 23.                                | 49. | 74. | 97.  | 122. | 146. | 165. | 184. | 200. | 215. |
| 7160.90                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 165. | 184. | 200. | 215. |
| 7161.00                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 165. | 184. | 200. | 215. |
| 7161.10                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 165. | 184. | 200. | 216. |
| 7161.20                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 166. | 184. | 201. | 216. |
| 7161.30                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 166. | 184. | 201. | 216. |
| 7161.40                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 166. | 185. | 201. | 216. |
| 7161.50                 | 23.                                | 49. | 74. | 98.  | 122. | 146. | 166. | 185. | 201. | 216. |
| 7161.60                 | 24.                                | 49. | 74. | 98.  | 122. | 147. | 166. | 185. | 201. | 217. |
| 7161.70                 | 24.                                | 50. | 75. | 98.  | 123. | 147. | 166. | 185. | 202. | 217. |
| 7161.80                 | 24.                                | 50. | 75. | 98.  | 123. | 147. | 166. | 185. | 202. | 217. |
| 7161.90                 | 24.                                | 50. | 75. | 98.  | 123. | 147. | 167. | 185. | 202. | 217. |
| 7162.00                 | 24.                                | 50. | 75. | 98.  | 123. | 147. | 167. | 186. | 202. | 217. |
| 7162.10                 | 24.                                | 50. | 75. | 99.  | 123. | 147. | 167. | 186. | 202. | 218. |
| 7162.20                 | 24.                                | 50. | 75. | 99.  | 123. | 147. | 167. | 186. | 202. | 218. |
| 7162.30                 | 24.                                | 50. | 75. | 99.  | 123. | 148. | 167. | 186. | 203. | 218. |
| 7162.40                 | 24.                                | 50. | 75. | 99.  | 123. | 148. | 167. | 186. | 203. | 218. |
| 7162.50                 | 24.                                | 50. | 75. | 99.  | 123. | 148. | 167. | 186. | 203. | 218. |
| 7162.60                 | 24.                                | 50. | 75. | 99.  | 124. | 148. | 168. | 187. | 203. | 219. |
| 7162.70                 | 24.                                | 50. | 75. | 99.  | 124. | 148. | 168. | 187. | 203. | 219. |
| 7162.80                 | 24.                                | 50. | 75. | 99.  | 124. | 148. | 168. | 187. | 203. | 219. |
| 7162.90                 | 24.                                | 50. | 75. | 99.  | 124. | 148. | 168. | 187. | 204. | 219. |
| 7163.00                 | 24.                                | 50. | 75. | 99.  | 124. | 148. | 168. | 187. | 204. | 219. |
| 7163.10                 | 24.                                | 50. | 75. | 99.  | 124. | 149. | 168. | 187. | 204. | 220. |
| 7163.20                 | 24.                                | 50. | 76. | 100. | 124. | 149. | 168. | 188. | 204. | 220. |
| 7163.30                 | 24.                                | 50. | 76. | 100. | 124. | 149. | 169. | 188. | 204. | 220. |
| 7163.40                 | 24.                                | 50. | 76. | 100. | 124. | 149. | 169. | 188. | 205. | 220. |
| 7163.50                 | 24.                                | 50. | 76. | 100. | 125. | 149. | 169. | 188. | 205. | 220. |
| 7163.60                 | 24.                                | 50. | 76. | 100. | 125. | 149. | 169. | 188. | 205. | 220. |
| 7163.70                 | 24.                                | 50. | 76. | 100. | 125. | 149. | 169. | 188. | 205. | 221. |
| 7163.80                 | 24.                                | 50. | 76. | 100. | 125. | 149. | 169. | 189. | 205. | 221. |
| 7163.90                 | 24.                                | 50. | 76. | 100. | 125. | 150. | 169. | 189. | 205. | 221. |
| 7164.00                 | 24.                                | 51. | 76. | 100. | 125. | 150. | 170. | 189. | 206. | 221. |
| 7164.10                 | 24.                                | 51. | 76. | 100. | 125. | 150. | 170. | 189. | 206. | 221. |
| 7164.20                 | 24.                                | 51. | 76. | 100. | 125. | 150. | 170. | 189. | 206. | 222. |
| 7164.30                 | 24.                                | 51. | 76. | 100. | 125. | 150. | 170. | 189. | 206. | 222. |
| 7164.40                 | 24.                                | 51. | 76. | 101. | 125. | 150. | 170. | 190. | 206. | 222. |
| 7164.50                 | 24.                                | 51. | 76. | 101. | 126. | 150. | 170. | 190. | 207. | 222. |
| 7164.60                 | 24.                                | 51. | 76. | 101. | 126. | 150. | 171. | 190. | 207. | 222. |
| 7164.70                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 190. | 207. | 223. |
| 7164.80                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 190. | 207. | 223. |
| 7164.90                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 190. | 207. | 223. |
| 7165.00                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 191. | 207. | 223. |
| 7165.10                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 191. | 208. | 223. |
| 7165.20                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 171. | 191. | 208. | 224. |
| 7165.30                 | 24.                                | 51. | 77. | 101. | 126. | 151. | 172. | 191. | 208. | 224. |
| 7165.40                 | 24.                                | 51. | 77. | 101. | 127. | 151. | 172. | 191. | 208. | 224. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
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DISCHARGE THRU SYSTEM

| WATER SURFACE ELEVATION | GATE OPENING |     |     |     |     |     |     |     |     |      |
|-------------------------|--------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
|                         | 10%          | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |

|         |     |     |     |      |      |      |      |      |      |      |
|---------|-----|-----|-----|------|------|------|------|------|------|------|
| 7165.50 | 24. | 51. | 77. | 101. | 127. | 152. | 172. | 191. | 208. | 224. |
| 7165.60 | 24. | 51. | 77. | 102. | 127. | 152. | 172. | 191. | 208. | 224. |
| 7165.70 | 24. | 51. | 77. | 102. | 127. | 152. | 172. | 192. | 209. | 224. |
| 7165.80 | 24. | 51. | 77. | 102. | 127. | 152. | 172. | 192. | 209. | 225. |
| 7165.90 | 24. | 51. | 77. | 102. | 127. | 152. | 172. | 192. | 209. | 225. |
| 7166.00 | 24. | 51. | 77. | 102. | 127. | 152. | 173. | 192. | 209. | 225. |
| 7166.10 | 24. | 51. | 77. | 102. | 127. | 152. | 173. | 192. | 209. | 225. |
| 7166.20 | 24. | 51. | 77. | 102. | 127. | 153. | 173. | 192. | 209. | 225. |
| 7166.30 | 24. | 52. | 78. | 102. | 127. | 153. | 173. | 193. | 210. | 226. |
| 7166.40 | 24. | 52. | 78. | 102. | 128. | 153. | 173. | 193. | 210. | 226. |
| 7166.50 | 25. | 52. | 78. | 102. | 128. | 153. | 173. | 193. | 210. | 226. |
| 7166.60 | 25. | 52. | 78. | 102. | 128. | 153. | 173. | 193. | 210. | 226. |
| 7166.70 | 25. | 52. | 78. | 103. | 128. | 153. | 174. | 193. | 210. | 226. |
| 7166.80 | 25. | 52. | 78. | 103. | 128. | 153. | 174. | 193. | 211. | 226. |
| 7166.90 | 25. | 52. | 78. | 103. | 128. | 153. | 174. | 194. | 211. | 227. |
| 7167.00 | 25. | 52. | 78. | 103. | 128. | 154. | 174. | 194. | 211. | 227. |
| 7167.10 | 25. | 52. | 78. | 103. | 128. | 154. | 174. | 194. | 211. | 227. |
| 7167.20 | 25. | 52. | 78. | 103. | 128. | 154. | 174. | 194. | 211. | 227. |
| 7167.30 | 25. | 52. | 78. | 103. | 129. | 154. | 174. | 194. | 211. | 227. |
| 7167.40 | 25. | 52. | 78. | 103. | 129. | 154. | 175. | 194. | 212. | 228. |
| 7167.50 | 25. | 52. | 78. | 103. | 129. | 154. | 175. | 195. | 212. | 228. |
| 7167.60 | 25. | 52. | 78. | 103. | 129. | 154. | 175. | 195. | 212. | 228. |
| 7167.70 | 25. | 52. | 78. | 103. | 129. | 154. | 175. | 195. | 212. | 228. |
| 7167.80 | 25. | 52. | 79. | 103. | 129. | 155. | 175. | 195. | 212. | 228. |
| 7167.90 | 25. | 52. | 79. | 104. | 129. | 155. | 175. | 195. | 212. | 229. |
| 7168.00 | 25. | 52. | 79. | 104. | 129. | 155. | 175. | 195. | 213. | 229. |
| 7168.10 | 25. | 52. | 79. | 104. | 129. | 155. | 176. | 195. | 213. | 229. |
| 7168.20 | 25. | 52. | 79. | 104. | 129. | 155. | 176. | 196. | 213. | 229. |
| 7168.30 | 25. | 52. | 79. | 104. | 130. | 155. | 176. | 196. | 213. | 229. |
| 7168.40 | 25. | 52. | 79. | 104. | 130. | 155. | 176. | 196. | 213. | 229. |
| 7168.50 | 25. | 52. | 79. | 104. | 130. | 155. | 176. | 196. | 213. | 230. |
| 7168.60 | 25. | 52. | 79. | 104. | 130. | 156. | 176. | 196. | 214. | 230. |
| 7168.70 | 25. | 53. | 79. | 104. | 130. | 156. | 176. | 196. | 214. | 230. |
| 7168.80 | 25. | 53. | 79. | 104. | 130. | 156. | 176. | 197. | 214. | 230. |
| 7168.90 | 25. | 53. | 79. | 104. | 130. | 156. | 177. | 197. | 214. | 230. |
| 7169.00 | 25. | 53. | 79. | 104. | 130. | 156. | 177. | 197. | 214. | 231. |
| 7169.10 | 25. | 53. | 79. | 104. | 130. | 156. | 177. | 197. | 214. | 231. |
| 7169.20 | 25. | 53. | 79. | 105. | 131. | 156. | 177. | 197. | 215. | 231. |
| 7169.30 | 25. | 53. | 79. | 105. | 131. | 156. | 177. | 197. | 215. | 231. |
| 7169.40 | 25. | 53. | 80. | 105. | 131. | 156. | 177. | 197. | 215. | 231. |
| 7169.50 | 25. | 53. | 80. | 105. | 131. | 157. | 177. | 198. | 215. | 231. |
| 7169.60 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 198. | 215. | 232. |
| 7169.70 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 198. | 215. | 232. |
| 7169.80 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 198. | 216. | 232. |
| 7169.90 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 198. | 216. | 232. |
| 7170.00 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 198. | 216. | 232. |
| 7170.10 | 25. | 53. | 80. | 105. | 131. | 157. | 178. | 199. | 216. | 233. |
| 7170.20 | 25. | 53. | 80. | 105. | 132. | 157. | 178. | 199. | 216. | 233. |
| 7170.30 | 25. | 53. | 80. | 105. | 132. | 158. | 179. | 199. | 216. | 233. |
| 7170.40 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 199. | 217. | 233. |
| 7170.50 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 199. | 217. | 233. |
| 7170.60 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 199. | 217. | 233. |
| 7170.70 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 199. | 217. | 234. |
| 7170.80 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 200. | 217. | 234. |
| 7170.90 | 25. | 53. | 80. | 106. | 132. | 158. | 179. | 200. | 217. | 234. |
| 7171.00 | 25. | 53. | 81. | 106. | 132. | 158. | 180. | 200. | 218. | 234. |
| 7171.10 | 25. | 54. | 81. | 106. | 132. | 159. | 180. | 200. | 218. | 234. |
| 7171.20 | 25. | 54. | 81. | 106. | 133. | 159. | 180. | 200. | 218. | 235. |
| 7171.30 | 25. | 54. | 81. | 106. | 133. | 159. | 180. | 200. | 218. | 235. |
| 7171.40 | 25. | 54. | 81. | 106. | 133. | 159. | 180. | 201. | 218. | 235. |
| 7171.50 | 26. | 54. | 81. | 106. | 133. | 159. | 180. | 201. | 218. | 235. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| ELEVATION | DISCHARGE THRU SYSTEM |     |     |      |      |              |      |      |      |      |
|-----------|-----------------------|-----|-----|------|------|--------------|------|------|------|------|
|           | WATER SURFACE         |     |     |      |      | GATE OPENING |      |      |      |      |
|           | 10%                   | 20% | 30% | 40%  | 50%  | 60%          | 70%  | 80%  | 90%  | 100% |
| 7171.60   | 26.                   | 54. | 81. | 107. | 133. | 159.         | 180. | 201. | 219. | 235. |
| 7171.70   | 26.                   | 54. | 81. | 107. | 133. | 159.         | 180. | 201. | 219. | 235. |
| 7171.80   | 26.                   | 54. | 81. | 107. | 133. | 159.         | 181. | 201. | 219. | 236. |
| 7171.90   | 26.                   | 54. | 81. | 107. | 133. | 160.         | 181. | 201. | 219. | 236. |
| 7172.00   | 26.                   | 54. | 81. | 107. | 133. | 160.         | 181. | 201. | 219. | 236. |
| 7172.10   | 26.                   | 54. | 81. | 107. | 133. | 160.         | 181. | 202. | 219. | 236. |
| 7172.20   | 26.                   | 54. | 81. | 107. | 134. | 160.         | 181. | 202. | 220. | 236. |
| 7172.30   | 26.                   | 54. | 81. | 107. | 134. | 160.         | 181. | 202. | 220. | 236. |
| 7172.40   | 26.                   | 54. | 81. | 107. | 134. | 160.         | 181. | 202. | 220. | 237. |
| 7172.50   | 26.                   | 54. | 81. | 107. | 134. | 160.         | 182. | 202. | 220. | 237. |
| 7172.60   | 26.                   | 54. | 81. | 107. | 134. | 160.         | 182. | 202. | 220. | 237. |
| 7172.70   | 26.                   | 54. | 82. | 107. | 134. | 160.         | 182. | 203. | 220. | 237. |
| 7172.80   | 26.                   | 54. | 82. | 108. | 134. | 161.         | 182. | 203. | 221. | 237. |
| 7172.90   | 26.                   | 54. | 82. | 108. | 134. | 161.         | 182. | 203. | 221. | 238. |
| 7173.00   | 26.                   | 54. | 82. | 108. | 134. | 161.         | 182. | 203. | 221. | 238. |
| 7173.10   | 26.                   | 54. | 82. | 108. | 134. | 161.         | 182. | 203. | 221. | 238. |
| 7173.20   | 26.                   | 54. | 82. | 108. | 135. | 161.         | 183. | 203. | 221. | 238. |
| 7173.30   | 26.                   | 54. | 82. | 108. | 135. | 161.         | 183. | 203. | 221. | 238. |
| 7173.40   | 26.                   | 54. | 82. | 108. | 135. | 161.         | 183. | 204. | 222. | 238. |
| 7173.50   | 26.                   | 54. | 82. | 108. | 135. | 161.         | 183. | 204. | 222. | 239. |
| 7173.60   | 26.                   | 55. | 82. | 108. | 135. | 162.         | 183. | 204. | 222. | 239. |
| 7173.70   | 26.                   | 55. | 82. | 108. | 135. | 162.         | 183. | 204. | 222. | 239. |
| 7173.80   | 26.                   | 55. | 82. | 108. | 135. | 162.         | 183. | 204. | 222. | 239. |
| 7173.90   | 26.                   | 55. | 82. | 108. | 135. | 162.         | 183. | 204. | 222. | 239. |
| 7174.00   | 26.                   | 55. | 82. | 108. | 135. | 162.         | 184. | 204. | 223. | 239. |
| 7174.10   | 26.                   | 55. | 82. | 109. | 135. | 162.         | 184. | 205. | 223. | 240. |
| 7174.20   | 26.                   | 55. | 82. | 109. | 136. | 162.         | 184. | 205. | 223. | 240. |
| 7174.30   | 26.                   | 55. | 83. | 109. | 136. | 162.         | 184. | 205. | 223. | 240. |
| 7174.40   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 184. | 205. | 223. | 240. |
| 7174.50   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 184. | 205. | 223. | 240. |
| 7174.60   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 184. | 205. | 224. | 241. |
| 7174.70   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 185. | 206. | 224. | 241. |
| 7174.80   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 185. | 206. | 224. | 241. |
| 7174.90   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 185. | 206. | 224. | 241. |
| 7175.00   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 185. | 206. | 224. | 241. |
| 7175.10   | 26.                   | 55. | 83. | 109. | 136. | 163.         | 185. | 206. | 224. | 241. |
| 7175.20   | 26.                   | 55. | 83. | 109. | 137. | 163.         | 185. | 206. | 225. | 242. |
| 7175.30   | 26.                   | 55. | 83. | 109. | 137. | 164.         | 185. | 206. | 225. | 242. |
| 7175.40   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 185. | 207. | 225. | 242. |
| 7175.50   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 186. | 207. | 225. | 242. |
| 7175.60   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 186. | 207. | 225. | 242. |
| 7175.70   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 186. | 207. | 225. | 242. |
| 7175.80   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 186. | 207. | 225. | 243. |
| 7175.90   | 26.                   | 55. | 83. | 110. | 137. | 164.         | 186. | 207. | 226. | 243. |
| 7176.00   | 26.                   | 55. | 84. | 110. | 137. | 164.         | 186. | 207. | 226. | 243. |
| 7176.10   | 26.                   | 56. | 84. | 110. | 137. | 165.         | 186. | 208. | 226. | 243. |
| 7176.20   | 26.                   | 56. | 84. | 110. | 138. | 165.         | 187. | 208. | 226. | 243. |
| 7176.30   | 26.                   | 56. | 84. | 110. | 138. | 165.         | 187. | 208. | 226. | 243. |
| 7176.40   | 26.                   | 56. | 84. | 110. | 138. | 165.         | 187. | 208. | 226. | 244. |
| 7176.50   | 26.                   | 56. | 84. | 110. | 138. | 165.         | 187. | 208. | 227. | 244. |
| 7176.60   | 26.                   | 56. | 84. | 111. | 138. | 165.         | 187. | 208. | 227. | 244. |
| 7176.70   | 26.                   | 56. | 84. | 111. | 138. | 165.         | 187. | 208. | 227. | 244. |
| 7176.80   | 27.                   | 56. | 84. | 111. | 138. | 165.         | 187. | 209. | 227. | 244. |
| 7176.90   | 27.                   | 56. | 84. | 111. | 138. | 165.         | 187. | 209. | 227. | 245. |
| 7177.00   | 27.                   | 56. | 84. | 111. | 138. | 166.         | 188. | 209. | 227. | 245. |
| 7177.10   | 27.                   | 56. | 84. | 111. | 138. | 166.         | 188. | 209. | 228. | 245. |
| 7177.20   | 27.                   | 56. | 84. | 111. | 138. | 166.         | 188. | 209. | 228. | 245. |
| 7177.30   | 27.                   | 56. | 84. | 111. | 139. | 166.         | 188. | 209. | 228. | 245. |
| 7177.40   | 27.                   | 56. | 84. | 111. | 139. | 166.         | 188. | 210. | 228. | 245. |
| 7177.50   | 27.                   | 56. | 84. | 111. | 139. | 166.         | 188. | 210. | 228. | 246. |
| 7177.60   | 27.                   | 56. | 84. | 111. | 139. | 166.         | 188. | 210. | 228. | 246. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| ELEVATION | DISCHARGE THRU SYSTEM |     |              |      |      |      |      |      |      |      |
|-----------|-----------------------|-----|--------------|------|------|------|------|------|------|------|
|           | WATER SURFACE         |     | GATE OPENING |      |      |      |      |      |      |      |
|           | 10%                   | 20% | 30%          | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7177.70   | 27.                   | 56. | 85.          | 111. | 139. | 166. | 189. | 210. | 229. | 246. |
| 7177.80   | 27.                   | 56. | 85.          | 111. | 139. | 166. | 189. | 210. | 229. | 246. |
| 7177.90   | 27.                   | 56. | 85.          | 112. | 139. | 167. | 189. | 210. | 229. | 246. |
| 7178.00   | 27.                   | 56. | 85.          | 112. | 139. | 167. | 189. | 210. | 229. | 246. |
| 7178.10   | 27.                   | 56. | 85.          | 112. | 139. | 167. | 189. | 211. | 229. | 247. |
| 7178.20   | 27.                   | 56. | 85.          | 112. | 139. | 167. | 189. | 211. | 229. | 247. |
| 7178.30   | 27.                   | 56. | 85.          | 112. | 140. | 167. | 189. | 211. | 229. | 247. |
| 7178.40   | 27.                   | 56. | 85.          | 112. | 140. | 167. | 189. | 211. | 230. | 247. |
| 7178.50   | 27.                   | 56. | 85.          | 112. | 140. | 167. | 190. | 211. | 230. | 247. |
| 7178.60   | 27.                   | 57. | 85.          | 112. | 140. | 167. | 190. | 211. | 230. | 247. |
| 7178.70   | 27.                   | 57. | 85.          | 112. | 140. | 168. | 190. | 211. | 230. | 248. |
| 7178.80   | 27.                   | 57. | 85.          | 112. | 140. | 168. | 190. | 212. | 230. | 248. |
| 7178.90   | 27.                   | 57. | 85.          | 112. | 140. | 168. | 190. | 212. | 230. | 248. |
| 7179.00   | 27.                   | 57. | 85.          | 112. | 140. | 168. | 190. | 212. | 231. | 248. |
| 7179.10   | 27.                   | 57. | 85.          | 112. | 140. | 168. | 190. | 212. | 231. | 248. |
| 7179.20   | 27.                   | 57. | 85.          | 113. | 140. | 168. | 190. | 212. | 231. | 248. |
| 7179.30   | 27.                   | 57. | 85.          | 113. | 141. | 168. | 191. | 212. | 231. | 249. |
| 7179.40   | 27.                   | 57. | 86.          | 113. | 141. | 168. | 191. | 212. | 231. | 249. |
| 7179.50   | 27.                   | 57. | 86.          | 113. | 141. | 168. | 191. | 213. | 231. | 249. |
| 7179.60   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 191. | 213. | 232. | 249. |
| 7179.70   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 191. | 213. | 232. | 249. |
| 7179.80   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 191. | 213. | 232. | 249. |
| 7179.90   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 191. | 213. | 232. | 250. |
| 7180.00   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 192. | 213. | 232. | 250. |
| 7180.10   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 192. | 213. | 232. | 250. |
| 7180.20   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 192. | 214. | 232. | 250. |
| 7180.30   | 27.                   | 57. | 86.          | 113. | 141. | 169. | 192. | 214. | 233. | 250. |
| 7180.40   | 27.                   | 57. | 86.          | 113. | 142. | 169. | 192. | 214. | 233. | 250. |
| 7180.50   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 192. | 214. | 233. | 251. |
| 7180.60   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 192. | 214. | 233. | 251. |
| 7180.70   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 192. | 214. | 233. | 251. |
| 7180.80   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 193. | 214. | 233. | 251. |
| 7180.90   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 193. | 215. | 234. | 251. |
| 7181.00   | 27.                   | 57. | 86.          | 114. | 142. | 170. | 193. | 215. | 234. | 251. |
| 7181.10   | 27.                   | 57. | 87.          | 114. | 142. | 170. | 193. | 215. | 234. | 252. |
| 7181.20   | 27.                   | 58. | 87.          | 114. | 142. | 170. | 193. | 215. | 234. | 252. |
| 7181.30   | 27.                   | 58. | 87.          | 114. | 142. | 170. | 193. | 215. | 234. | 252. |
| 7181.40   | 27.                   | 58. | 87.          | 114. | 142. | 171. | 193. | 215. | 234. | 252. |
| 7181.50   | 27.                   | 58. | 87.          | 114. | 143. | 171. | 193. | 215. | 234. | 252. |
| 7181.60   | 27.                   | 58. | 87.          | 114. | 143. | 171. | 194. | 216. | 235. | 252. |
| 7181.70   | 27.                   | 58. | 87.          | 114. | 143. | 171. | 194. | 216. | 235. | 253. |
| 7181.80   | 27.                   | 58. | 87.          | 114. | 143. | 171. | 194. | 216. | 235. | 253. |
| 7181.90   | 27.                   | 58. | 87.          | 115. | 143. | 171. | 194. | 216. | 235. | 253. |
| 7182.00   | 27.                   | 58. | 87.          | 115. | 143. | 171. | 194. | 216. | 235. | 253. |
| 7182.10   | 27.                   | 58. | 87.          | 115. | 143. | 171. | 194. | 216. | 235. | 253. |
| 7182.20   | 27.                   | 58. | 87.          | 115. | 143. | 171. | 194. | 216. | 236. | 253. |
| 7182.30   | 28.                   | 58. | 87.          | 115. | 143. | 172. | 194. | 217. | 236. | 254. |
| 7182.40   | 28.                   | 58. | 87.          | 115. | 143. | 172. | 195. | 217. | 236. | 254. |
| 7182.50   | 28.                   | 58. | 87.          | 115. | 144. | 172. | 195. | 217. | 236. | 254. |
| 7182.60   | 28.                   | 58. | 87.          | 115. | 144. | 172. | 195. | 217. | 236. | 254. |
| 7182.70   | 28.                   | 58. | 87.          | 115. | 144. | 172. | 195. | 217. | 236. | 254. |
| 7182.80   | 28.                   | 58. | 87.          | 115. | 144. | 172. | 195. | 217. | 236. | 254. |
| 7182.90   | 28.                   | 58. | 88.          | 115. | 144. | 172. | 195. | 217. | 237. | 255. |
| 7183.00   | 28.                   | 58. | 88.          | 115. | 144. | 172. | 195. | 218. | 237. | 255. |
| 7183.10   | 28.                   | 58. | 88.          | 115. | 144. | 173. | 195. | 218. | 237. | 255. |
| 7183.20   | 28.                   | 58. | 88.          | 116. | 144. | 173. | 196. | 218. | 237. | 255. |
| 7183.30   | 28.                   | 58. | 88.          | 116. | 144. | 173. | 196. | 218. | 237. | 255. |
| 7183.40   | 28.                   | 58. | 88.          | 116. | 144. | 173. | 196. | 218. | 237. | 255. |
| 7183.50   | 28.                   | 58. | 88.          | 116. | 144. | 173. | 196. | 218. | 238. | 256. |
| 7183.60   | 28.                   | 58. | 88.          | 116. | 145. | 173. | 196. | 218. | 238. | 256. |
| 7183.70   | 28.                   | 58. | 88.          | 116. | 145. | 173. | 196. | 219. | 238. | 256. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
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| ELEVATION | DISCHARGE THRU SYSTEM |     |              |      |      |      |      |      |      |      |
|-----------|-----------------------|-----|--------------|------|------|------|------|------|------|------|
|           | WATER SURFACE         |     | GATE OPENING |      |      |      |      |      |      |      |
|           | 10%                   | 20% | 30%          | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7183.80   | 28.                   | 58. | 88.          | 116. | 145. | 173. | 196. | 219. | 238. | 256. |
| 7183.90   | 28.                   | 59. | 88.          | 116. | 145. | 173. | 196. | 219. | 238. | 256. |
| 7184.00   | 28.                   | 59. | 88.          | 116. | 145. | 174. | 197. | 219. | 238. | 256. |
| 7184.10   | 28.                   | 59. | 88.          | 116. | 145. | 174. | 197. | 219. | 238. | 257. |
| 7184.20   | 28.                   | 59. | 88.          | 116. | 145. | 174. | 197. | 219. | 239. | 257. |
| 7184.30   | 28.                   | 59. | 88.          | 116. | 145. | 174. | 197. | 219. | 239. | 257. |
| 7184.40   | 28.                   | 59. | 88.          | 116. | 145. | 174. | 197. | 220. | 239. | 257. |
| 7184.50   | 28.                   | 59. | 88.          | 117. | 145. | 174. | 197. | 220. | 239. | 257. |
| 7184.60   | 28.                   | 59. | 88.          | 117. | 145. | 174. | 197. | 220. | 239. | 257. |
| 7184.70   | 28.                   | 59. | 89.          | 117. | 146. | 174. | 197. | 220. | 239. | 258. |
| 7184.80   | 28.                   | 59. | 89.          | 117. | 146. | 174. | 198. | 220. | 240. | 258. |
| 7184.90   | 28.                   | 59. | 89.          | 117. | 146. | 174. | 198. | 220. | 240. | 258. |
| 7185.00   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 220. | 240. | 258. |
| 7185.10   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 220. | 240. | 258. |
| 7185.20   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 221. | 240. | 258. |
| 7185.30   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 221. | 240. | 259. |
| 7185.40   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 221. | 240. | 259. |
| 7185.50   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 198. | 221. | 241. | 259. |
| 7185.60   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 199. | 221. | 241. | 259. |
| 7185.70   | 28.                   | 59. | 89.          | 117. | 146. | 175. | 199. | 221. | 241. | 259. |
| 7185.80   | 28.                   | 59. | 89.          | 117. | 147. | 175. | 199. | 221. | 241. | 259. |
| 7185.90   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 199. | 222. | 241. | 260. |
| 7186.00   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 199. | 222. | 241. | 260. |
| 7186.10   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 199. | 222. | 242. | 260. |
| 7186.20   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 199. | 222. | 242. | 260. |
| 7186.30   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 199. | 222. | 242. | 260. |
| 7186.40   | 28.                   | 59. | 89.          | 118. | 147. | 176. | 200. | 222. | 242. | 260. |
| 7186.50   | 28.                   | 59. | 90.          | 118. | 147. | 176. | 200. | 222. | 242. | 260. |
| 7186.60   | 28.                   | 60. | 90.          | 118. | 147. | 176. | 200. | 223. | 242. | 261. |
| 7186.70   | 28.                   | 60. | 90.          | 118. | 147. | 176. | 200. | 223. | 242. | 261. |
| 7186.80   | 28.                   | 60. | 90.          | 118. | 147. | 177. | 200. | 223. | 243. | 261. |
| 7186.90   | 28.                   | 60. | 90.          | 118. | 148. | 177. | 200. | 223. | 243. | 261. |
| 7187.00   | 28.                   | 60. | 90.          | 118. | 148. | 177. | 200. | 223. | 243. | 261. |
| 7187.10   | 28.                   | 60. | 90.          | 118. | 148. | 177. | 200. | 223. | 243. | 261. |
| 7187.20   | 28.                   | 60. | 90.          | 118. | 148. | 177. | 201. | 223. | 243. | 262. |
| 7187.30   | 28.                   | 60. | 90.          | 119. | 148. | 177. | 201. | 224. | 243. | 262. |
| 7187.40   | 28.                   | 60. | 90.          | 119. | 148. | 177. | 201. | 224. | 243. | 262. |
| 7187.50   | 28.                   | 60. | 90.          | 119. | 148. | 177. | 201. | 224. | 244. | 262. |
| 7187.60   | 28.                   | 60. | 90.          | 119. | 148. | 177. | 201. | 224. | 244. | 262. |
| 7187.70   | 28.                   | 60. | 90.          | 119. | 148. | 178. | 201. | 224. | 244. | 262. |
| 7187.80   | 28.                   | 60. | 90.          | 119. | 148. | 178. | 201. | 224. | 244. | 263. |
| 7187.90   | 29.                   | 60. | 90.          | 119. | 148. | 178. | 201. | 224. | 244. | 263. |
| 7188.00   | 29.                   | 60. | 90.          | 119. | 149. | 178. | 202. | 224. | 244. | 263. |
| 7188.10   | 29.                   | 60. | 90.          | 119. | 149. | 178. | 202. | 225. | 244. | 263. |
| 7188.20   | 29.                   | 60. | 90.          | 119. | 149. | 178. | 202. | 225. | 245. | 263. |
| 7188.30   | 29.                   | 60. | 91.          | 119. | 149. | 178. | 202. | 225. | 245. | 263. |
| 7188.40   | 29.                   | 60. | 91.          | 119. | 149. | 178. | 202. | 225. | 245. | 264. |
| 7188.50   | 29.                   | 60. | 91.          | 119. | 149. | 178. | 202. | 225. | 245. | 264. |
| 7188.60   | 29.                   | 60. | 91.          | 119. | 149. | 179. | 202. | 225. | 245. | 264. |
| 7188.70   | 29.                   | 60. | 91.          | 120. | 149. | 179. | 202. | 225. | 245. | 264. |
| 7188.80   | 29.                   | 60. | 91.          | 120. | 149. | 179. | 203. | 226. | 246. | 264. |
| 7188.90   | 29.                   | 60. | 91.          | 120. | 149. | 179. | 203. | 226. | 246. | 264. |
| 7189.00   | 29.                   | 60. | 91.          | 120. | 149. | 179. | 203. | 226. | 246. | 264. |
| 7189.10   | 29.                   | 60. | 91.          | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 7189.20   | 29.                   | 60. | 91.          | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 7189.30   | 29.                   | 61. | 91.          | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 7189.40   | 29.                   | 61. | 91.          | 120. | 150. | 179. | 203. | 226. | 246. | 265. |
| 7189.50   | 29.                   | 61. | 91.          | 120. | 150. | 179. | 203. | 227. | 247. | 265. |
| 7189.60   | 29.                   | 61. | 91.          | 120. | 150. | 180. | 204. | 227. | 247. | 265. |
| 7189.70   | 29.                   | 61. | 91.          | 120. | 150. | 180. | 204. | 227. | 247. | 266. |
| 7189.80   | 29.                   | 61. | 91.          | 120. | 150. | 180. | 204. | 227. | 247. | 266. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| WATER SURFACE ELEVATION | DISCHARGE THRU SYSTEM GATE OPENING |     |     |      |      |      |      |      |      |      |
|-------------------------|------------------------------------|-----|-----|------|------|------|------|------|------|------|
|                         | 10%                                | 20% | 30% | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7189.90                 | 29.                                | 61. | 91. | 120. | 150. | 180. | 204. | 227. | 247. | 266. |
| 7190.00                 | 29.                                | 61. | 91. | 121. | 150. | 180. | 204. | 227. | 247. | 266. |
| 7190.10                 | 29.                                | 61. | 92. | 121. | 150. | 180. | 204. | 227. | 247. | 266. |
| 7190.20                 | 29.                                | 61. | 92. | 121. | 151. | 180. | 204. | 227. | 248. | 266. |
| 7190.30                 | 29.                                | 61. | 92. | 121. | 151. | 180. | 204. | 228. | 248. | 267. |
| 7190.40                 | 29.                                | 61. | 92. | 121. | 151. | 180. | 204. | 228. | 248. | 267. |
| 7190.50                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 228. | 248. | 267. |
| 7190.60                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 228. | 248. | 267. |
| 7190.70                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 228. | 248. | 267. |
| 7190.80                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 228. | 248. | 267. |
| 7190.90                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 228. | 249. | 267. |
| 7191.00                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 229. | 249. | 268. |
| 7191.10                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 229. | 249. | 268. |
| 7191.20                 | 29.                                | 61. | 92. | 121. | 151. | 181. | 205. | 229. | 249. | 268. |
| 7191.30                 | 29.                                | 61. | 92. | 121. | 152. | 181. | 206. | 229. | 249. | 268. |
| 7191.40                 | 29.                                | 61. | 92. | 121. | 152. | 182. | 206. | 229. | 249. | 268. |
| 7191.50                 | 29.                                | 61. | 92. | 122. | 152. | 182. | 206. | 229. | 249. | 268. |
| 7191.60                 | 29.                                | 61. | 92. | 122. | 152. | 182. | 206. | 229. | 250. | 269. |
| 7191.70                 | 29.                                | 61. | 92. | 122. | 152. | 182. | 206. | 229. | 250. | 269. |
| 7191.80                 | 29.                                | 61. | 92. | 122. | 152. | 182. | 206. | 230. | 250. | 269. |
| 7191.90                 | 29.                                | 61. | 92. | 122. | 152. | 182. | 206. | 230. | 250. | 269. |
| 7192.00                 | 29.                                | 61. | 93. | 122. | 152. | 182. | 206. | 230. | 250. | 269. |
| 7192.10                 | 29.                                | 62. | 93. | 122. | 152. | 182. | 207. | 230. | 250. | 269. |
| 7192.20                 | 29.                                | 62. | 93. | 122. | 152. | 182. | 207. | 230. | 251. | 270. |
| 7192.30                 | 29.                                | 62. | 93. | 122. | 152. | 182. | 207. | 230. | 251. | 270. |
| 7192.40                 | 29.                                | 62. | 93. | 122. | 153. | 183. | 207. | 230. | 251. | 270. |
| 7192.50                 | 29.                                | 62. | 93. | 122. | 153. | 183. | 207. | 231. | 251. | 270. |
| 7192.60                 | 29.                                | 62. | 93. | 122. | 153. | 183. | 207. | 231. | 251. | 270. |
| 7192.70                 | 29.                                | 62. | 93. | 122. | 153. | 183. | 207. | 231. | 251. | 270. |
| 7192.80                 | 29.                                | 62. | 93. | 122. | 153. | 183. | 207. | 231. | 251. | 270. |
| 7192.90                 | 29.                                | 62. | 93. | 123. | 153. | 183. | 207. | 231. | 252. | 271. |
| 7193.00                 | 29.                                | 62. | 93. | 123. | 153. | 183. | 208. | 231. | 252. | 271. |
| 7193.10                 | 29.                                | 62. | 93. | 123. | 153. | 183. | 208. | 231. | 252. | 271. |
| 7193.20                 | 29.                                | 62. | 93. | 123. | 153. | 183. | 208. | 231. | 252. | 271. |
| 7193.30                 | 29.                                | 62. | 93. | 123. | 153. | 184. | 208. | 232. | 252. | 271. |
| 7193.40                 | 29.                                | 62. | 93. | 123. | 153. | 184. | 208. | 232. | 252. | 271. |
| 7193.50                 | 29.                                | 62. | 93. | 123. | 153. | 184. | 208. | 232. | 252. | 272. |
| 7193.60                 | 29.                                | 62. | 93. | 123. | 154. | 184. | 208. | 232. | 253. | 272. |
| 7193.70                 | 29.                                | 62. | 93. | 123. | 154. | 184. | 208. | 232. | 253. | 272. |
| 7193.80                 | 30.                                | 62. | 94. | 123. | 154. | 184. | 209. | 232. | 253. | 272. |
| 7193.90                 | 30.                                | 62. | 94. | 123. | 154. | 184. | 209. | 232. | 253. | 272. |
| 7194.00                 | 30.                                | 62. | 94. | 123. | 154. | 184. | 209. | 233. | 253. | 272. |
| 7194.10                 | 30.                                | 62. | 94. | 123. | 154. | 184. | 209. | 233. | 253. | 272. |
| 7194.20                 | 30.                                | 62. | 94. | 123. | 154. | 184. | 209. | 233. | 253. | 273. |
| 7194.30                 | 30.                                | 62. | 94. | 124. | 154. | 185. | 209. | 233. | 254. | 273. |
| 7194.40                 | 30.                                | 62. | 94. | 124. | 154. | 185. | 209. | 233. | 254. | 273. |
| 7194.50                 | 30.                                | 62. | 94. | 124. | 154. | 185. | 209. | 233. | 254. | 273. |
| 7194.60                 | 30.                                | 62. | 94. | 124. | 154. | 185. | 209. | 233. | 254. | 273. |
| 7194.70                 | 30.                                | 62. | 94. | 124. | 155. | 185. | 210. | 233. | 254. | 273. |
| 7194.80                 | 30.                                | 62. | 94. | 124. | 155. | 185. | 210. | 234. | 254. | 274. |
| 7194.90                 | 30.                                | 63. | 94. | 124. | 155. | 185. | 210. | 234. | 254. | 274. |
| 7195.00                 | 30.                                | 63. | 94. | 124. | 155. | 185. | 210. | 234. | 255. | 274. |
| 7195.10                 | 30.                                | 63. | 94. | 124. | 155. | 185. | 210. | 234. | 255. | 274. |
| 7195.20                 | 30.                                | 63. | 94. | 124. | 155. | 186. | 210. | 234. | 255. | 274. |
| 7195.30                 | 30.                                | 63. | 94. | 124. | 155. | 186. | 210. | 234. | 255. | 274. |
| 7195.40                 | 30.                                | 63. | 94. | 124. | 155. | 186. | 210. | 234. | 255. | 274. |
| 7195.50                 | 30.                                | 63. | 94. | 124. | 155. | 186. | 211. | 234. | 255. | 275. |
| 7195.60                 | 30.                                | 63. | 94. | 124. | 155. | 186. | 211. | 235. | 255. | 275. |
| 7195.70                 | 30.                                | 63. | 95. | 125. | 155. | 186. | 211. | 235. | 256. | 275. |
| 7195.80                 | 30.                                | 63. | 95. | 125. | 155. | 186. | 211. | 235. | 256. | 275. |
| 7195.90                 | 30.                                | 63. | 95. | 125. | 156. | 186. | 211. | 235. | 256. | 275. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| WATER SURFACE ELEVATION | DISCHARGE THRU SYSTEM GATE OPENING |     |     |      |      |      |      |      |      |      |
|-------------------------|------------------------------------|-----|-----|------|------|------|------|------|------|------|
|                         | 10%                                | 20% | 30% | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7196.00                 | 30.                                | 63. | 95. | 125. | 156. | 186. | 211. | 235. | 256. | 275. |
| 7196.10                 | 30.                                | 63. | 95. | 125. | 156. | 186. | 211. | 235. | 256. | 276. |
| 7196.20                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 211. | 235. | 256. | 276. |
| 7196.30                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 211. | 236. | 256. | 276. |
| 7196.40                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 276. |
| 7196.50                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 276. |
| 7196.60                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 276. |
| 7196.70                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 276. |
| 7196.80                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 277. |
| 7196.90                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 277. |
| 7197.00                 | 30.                                | 63. | 95. | 125. | 156. | 187. | 212. | 236. | 257. | 277. |
| 7197.10                 | 30.                                | 63. | 95. | 125. | 157. | 187. | 212. | 237. | 258. | 277. |
| 7197.20                 | 30.                                | 63. | 95. | 126. | 157. | 188. | 213. | 237. | 258. | 277. |
| 7197.30                 | 30.                                | 63. | 95. | 126. | 157. | 188. | 213. | 237. | 258. | 277. |
| 7197.40                 | 30.                                | 63. | 95. | 126. | 157. | 188. | 213. | 237. | 258. | 278. |
| 7197.50                 | 30.                                | 63. | 95. | 126. | 157. | 188. | 213. | 237. | 258. | 278. |
| 7197.60                 | 30.                                | 63. | 96. | 126. | 157. | 188. | 213. | 237. | 258. | 278. |
| 7197.70                 | 30.                                | 63. | 96. | 126. | 157. | 188. | 213. | 237. | 258. | 278. |
| 7197.80                 | 30.                                | 64. | 96. | 126. | 157. | 188. | 213. | 237. | 258. | 278. |
| 7197.90                 | 30.                                | 64. | 96. | 126. | 157. | 188. | 213. | 238. | 259. | 278. |
| 7198.00                 | 30.                                | 64. | 96. | 126. | 157. | 188. | 213. | 238. | 259. | 278. |
| 7198.10                 | 30.                                | 64. | 96. | 126. | 157. | 188. | 214. | 238. | 259. | 279. |
| 7198.20                 | 30.                                | 64. | 96. | 126. | 158. | 189. | 214. | 238. | 259. | 279. |
| 7198.30                 | 30.                                | 64. | 96. | 126. | 158. | 189. | 214. | 238. | 259. | 279. |
| 7198.40                 | 30.                                | 64. | 96. | 126. | 158. | 189. | 214. | 238. | 259. | 279. |
| 7198.50                 | 30.                                | 64. | 96. | 126. | 158. | 189. | 214. | 238. | 259. | 279. |
| 7198.60                 | 30.                                | 64. | 96. | 127. | 158. | 189. | 214. | 239. | 260. | 279. |
| 7198.70                 | 30.                                | 64. | 96. | 127. | 158. | 189. | 214. | 239. | 260. | 279. |
| 7198.80                 | 30.                                | 64. | 96. | 127. | 158. | 189. | 214. | 239. | 260. | 280. |
| 7198.90                 | 30.                                | 64. | 96. | 127. | 158. | 189. | 215. | 239. | 260. | 280. |
| 7199.00                 | 30.                                | 64. | 96. | 127. | 158. | 189. | 215. | 239. | 260. | 280. |
| 7199.10                 | 30.                                | 64. | 96. | 127. | 158. | 190. | 215. | 239. | 260. | 280. |
| 7199.20                 | 30.                                | 64. | 96. | 127. | 158. | 190. | 215. | 239. | 260. | 280. |
| 7199.30                 | 30.                                | 64. | 96. | 127. | 158. | 190. | 215. | 239. | 261. | 280. |
| 7199.40                 | 30.                                | 64. | 96. | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 7199.50                 | 30.                                | 64. | 96. | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 7199.60                 | 30.                                | 64. | 97. | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 7199.70                 | 30.                                | 64. | 97. | 127. | 159. | 190. | 215. | 240. | 261. | 281. |
| 7199.80                 | 30.                                | 64. | 97. | 127. | 159. | 190. | 216. | 240. | 261. | 281. |
| 7199.90                 | 31.                                | 64. | 97. | 127. | 159. | 190. | 216. | 240. | 261. | 281. |
| 7200.00                 | 31.                                | 64. | 97. | 127. | 159. | 190. | 216. | 240. | 262. | 281. |
| 7200.10                 | 31.                                | 64. | 97. | 128. | 159. | 191. | 216. | 240. | 262. | 282. |
| 7200.20                 | 31.                                | 64. | 97. | 128. | 159. | 191. | 216. | 241. | 262. | 282. |
| 7200.30                 | 31.                                | 64. | 97. | 128. | 159. | 191. | 216. | 241. | 262. | 282. |
| 7200.40                 | 31.                                | 64. | 97. | 128. | 159. | 191. | 216. | 241. | 262. | 282. |
| 7200.50                 | 31.                                | 64. | 97. | 128. | 159. | 191. | 216. | 241. | 262. | 282. |
| 7200.60                 | 31.                                | 64. | 97. | 128. | 160. | 191. | 216. | 241. | 262. | 282. |
| 7200.70                 | 31.                                | 65. | 97. | 128. | 160. | 191. | 217. | 241. | 263. | 282. |
| 7200.80                 | 31.                                | 65. | 97. | 128. | 160. | 191. | 217. | 241. | 263. | 283. |
| 7200.90                 | 31.                                | 65. | 97. | 128. | 160. | 191. | 217. | 241. | 263. | 283. |
| 7201.00                 | 31.                                | 65. | 97. | 128. | 160. | 191. | 217. | 242. | 263. | 283. |
| 7201.10                 | 31.                                | 65. | 97. | 128. | 160. | 192. | 217. | 242. | 263. | 283. |
| 7201.20                 | 31.                                | 65. | 97. | 128. | 160. | 192. | 217. | 242. | 263. | 283. |
| 7201.30                 | 31.                                | 65. | 97. | 128. | 160. | 192. | 217. | 242. | 263. | 283. |
| 7201.40                 | 31.                                | 65. | 97. | 128. | 160. | 192. | 217. | 242. | 263. | 284. |
| 7201.50                 | 31.                                | 65. | 98. | 128. | 160. | 192. | 217. | 242. | 264. | 284. |
| 7201.60                 | 31.                                | 65. | 98. | 129. | 160. | 192. | 218. | 242. | 264. | 284. |
| 7201.70                 | 31.                                | 65. | 98. | 129. | 160. | 192. | 218. | 242. | 264. | 284. |
| 7201.80                 | 31.                                | 65. | 98. | 129. | 161. | 192. | 218. | 243. | 264. | 284. |
| 7201.90                 | 31.                                | 65. | 98. | 129. | 161. | 192. | 218. | 243. | 264. | 284. |
| 7202.00                 | 31.                                | 65. | 98. | 129. | 161. | 192. | 218. | 243. | 264. | 284. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
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 HYDRAULICS BRANCH, DENVER OFFICE  
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| ELEVATION | DISCHARGE THRU SYSTEM |     |              |      |      |      |      |      |      |      |
|-----------|-----------------------|-----|--------------|------|------|------|------|------|------|------|
|           | WATER SURFACE         |     | GATE OPENING |      |      |      |      |      |      |      |
|           | 10%                   | 20% | 30%          | 40%  | 50%  | 60%  | 70%  | 80%  | 90%  | 100% |
| 7202.10   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 218. | 243. | 264. | 285. |
| 7202.20   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 218. | 243. | 265. | 285. |
| 7202.30   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 218. | 243. | 265. | 285. |
| 7202.40   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 243. | 265. | 285. |
| 7202.50   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 243. | 265. | 285. |
| 7202.60   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 244. | 265. | 285. |
| 7202.70   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 244. | 265. | 285. |
| 7202.80   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 244. | 265. | 286. |
| 7202.90   | 31.                   | 65. | 98.          | 129. | 161. | 193. | 219. | 244. | 266. | 286. |
| 7203.00   | 31.                   | 65. | 98.          | 129. | 162. | 193. | 219. | 244. | 266. | 286. |
| 7203.10   | 31.                   | 65. | 98.          | 130. | 162. | 194. | 219. | 244. | 266. | 286. |
| 7203.20   | 31.                   | 65. | 98.          | 130. | 162. | 194. | 219. | 244. | 266. | 286. |
| 7203.30   | 31.                   | 65. | 98.          | 130. | 162. | 194. | 220. | 244. | 266. | 286. |
| 7203.40   | 31.                   | 65. | 98.          | 130. | 162. | 194. | 220. | 245. | 266. | 286. |
| 7203.50   | 31.                   | 65. | 99.          | 130. | 162. | 194. | 220. | 245. | 266. | 287. |
| 7203.60   | 31.                   | 65. | 99.          | 130. | 162. | 194. | 220. | 245. | 267. | 287. |
| 7203.70   | 31.                   | 66. | 99.          | 130. | 162. | 194. | 220. | 245. | 267. | 287. |
| 7203.80   | 31.                   | 66. | 99.          | 130. | 162. | 194. | 220. | 245. | 267. | 287. |
| 7203.90   | 31.                   | 66. | 99.          | 130. | 162. | 194. | 220. | 245. | 267. | 287. |
| 7204.00   | 31.                   | 66. | 99.          | 130. | 162. | 194. | 220. | 245. | 267. | 287. |
| 7204.10   | 31.                   | 66. | 99.          | 130. | 162. | 195. | 220. | 245. | 267. | 287. |
| 7204.20   | 31.                   | 66. | 99.          | 130. | 163. | 195. | 221. | 246. | 267. | 288. |
| 7204.30   | 31.                   | 66. | 99.          | 130. | 163. | 195. | 221. | 246. | 267. | 288. |
| 7204.40   | 31.                   | 66. | 99.          | 130. | 163. | 195. | 221. | 246. | 268. | 288. |
| 7204.50   | 31.                   | 66. | 99.          | 130. | 163. | 195. | 221. | 246. | 268. | 288. |
| 7204.60   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 221. | 246. | 268. | 288. |
| 7204.70   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 221. | 246. | 268. | 288. |
| 7204.80   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 221. | 246. | 268. | 289. |
| 7204.90   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 221. | 246. | 268. | 289. |
| 7205.00   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 221. | 247. | 268. | 289. |
| 7205.10   | 31.                   | 66. | 99.          | 131. | 163. | 195. | 222. | 247. | 269. | 289. |
| 7205.20   | 31.                   | 66. | 99.          | 131. | 163. | 196. | 222. | 247. | 269. | 289. |
| 7205.30   | 31.                   | 66. | 99.          | 131. | 163. | 196. | 222. | 247. | 269. | 289. |
| 7205.40   | 31.                   | 66. | 99.          | 131. | 164. | 196. | 222. | 247. | 269. | 289. |
| 7205.50   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 222. | 247. | 269. | 290. |
| 7205.60   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 222. | 247. | 269. | 290. |
| 7205.70   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 222. | 247. | 269. | 290. |
| 7205.80   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 222. | 248. | 269. | 290. |
| 7205.90   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 222. | 248. | 270. | 290. |
| 7206.00   | 31.                   | 66. | 100.         | 131. | 164. | 196. | 223. | 248. | 270. | 290. |
| 7206.10   | 31.                   | 66. | 100.         | 132. | 164. | 196. | 223. | 248. | 270. | 290. |
| 7206.20   | 32.                   | 66. | 100.         | 132. | 164. | 197. | 223. | 248. | 270. | 291. |
| 7206.30   | 32.                   | 66. | 100.         | 132. | 164. | 197. | 223. | 248. | 270. | 291. |
| 7206.40   | 32.                   | 66. | 100.         | 132. | 164. | 197. | 223. | 248. | 270. | 291. |
| 7206.50   | 32.                   | 66. | 100.         | 132. | 164. | 197. | 223. | 248. | 270. | 291. |
| 7206.60   | 32.                   | 66. | 100.         | 132. | 165. | 197. | 223. | 249. | 271. | 291. |
| 7206.70   | 32.                   | 67. | 100.         | 132. | 165. | 197. | 223. | 249. | 271. | 291. |
| 7206.80   | 32.                   | 67. | 100.         | 132. | 165. | 197. | 223. | 249. | 271. | 291. |
| 7206.90   | 32.                   | 67. | 100.         | 132. | 165. | 197. | 224. | 249. | 271. | 292. |
| 7207.00   | 32.                   | 67. | 100.         | 132. | 165. | 197. | 224. | 249. | 271. | 292. |
| 7207.10   | 32.                   | 67. | 100.         | 132. | 165. | 197. | 224. | 249. | 271. | 292. |
| 7207.20   | 32.                   | 67. | 100.         | 132. | 165. | 198. | 224. | 249. | 271. | 292. |
| 7207.30   | 32.                   | 67. | 100.         | 132. | 165. | 198. | 224. | 249. | 272. | 292. |
| 7207.40   | 32.                   | 67. | 100.         | 132. | 165. | 198. | 224. | 250. | 272. | 292. |
| 7207.50   | 32.                   | 67. | 101.         | 132. | 165. | 198. | 224. | 250. | 272. | 292. |
| 7207.60   | 32.                   | 67. | 101.         | 132. | 165. | 198. | 224. | 250. | 272. | 293. |
| 7207.70   | 32.                   | 67. | 101.         | 133. | 165. | 198. | 224. | 250. | 272. | 293. |
| 7207.80   | 32.                   | 67. | 101.         | 133. | 165. | 198. | 225. | 250. | 272. | 293. |
| 7207.90   | 32.                   | 67. | 101.         | 133. | 166. | 198. | 225. | 250. | 272. | 293. |
| 7208.00   | 32.                   | 67. | 101.         | 133. | 166. | 198. | 225. | 250. | 272. | 293. |
| 7208.10   | 32.                   | 67. | 101.         | 133. | 166. | 198. | 225. | 250. | 273. | 293. |

GRASSY LAKE CLAMSHELL GATE INSTALLATION  
 MAY 30, 1990 RODNEY J. WITTLER, JERRY R. FITZWATER  
 HYDRAULICS BRANCH, DENVER OFFICE  
 ENGLISH UNITS AND COLEBROOK-WHITE FORMULA ARE USED (DARCY f)

| WATER SURFACE ELEVATION | DISCHARGE THRU SYSTEM GATE OPENING |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------------|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                         | 10%                                |      | 20%  |      | 30%  |      | 40%  |      | 50%  |      | 60%  |      | 70%  |      | 80%  |      | 90%  |      | 100% |      |
|                         | 101.                               | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. | 101. | 133. |
| 7208.20                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 225. | 251. | 273. | 293. |      |      |      |      |      |      |      |      |      |      |
| 7208.30                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 225. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.40                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 225. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.50                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 225. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.60                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 225. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.70                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 226. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.80                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 226. | 251. | 273. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7208.90                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 226. | 251. | 274. | 294. |      |      |      |      |      |      |      |      |      |      |
| 7209.00                 | 32.                                | 67.  | 101. | 133. | 166. | 199. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.10                 | 32.                                | 67.  | 101. | 133. | 167. | 199. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.20                 | 32.                                | 67.  | 101. | 134. | 167. | 199. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.30                 | 32.                                | 67.  | 101. | 134. | 167. | 200. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.40                 | 32.                                | 67.  | 101. | 134. | 167. | 200. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.50                 | 32.                                | 67.  | 101. | 134. | 167. | 200. | 226. | 252. | 274. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.60                 | 32.                                | 67.  | 102. | 134. | 167. | 200. | 226. | 252. | 275. | 295. |      |      |      |      |      |      |      |      |      |      |
| 7209.70                 | 32.                                | 67.  | 102. | 134. | 167. | 200. | 227. | 252. | 275. | 296. |      |      |      |      |      |      |      |      |      |      |
| 7209.80                 | 32.                                | 68.  | 102. | 134. | 167. | 200. | 227. | 252. | 275. | 296. |      |      |      |      |      |      |      |      |      |      |
| 7209.90                 | 32.                                | 68.  | 102. | 134. | 167. | 200. | 227. | 253. | 275. | 296. |      |      |      |      |      |      |      |      |      |      |
| 7210.00                 | 32.                                | 68.  | 102. | 134. | 167. | 200. | 227. | 253. | 275. | 296. |      |      |      |      |      |      |      |      |      |      |



### **Mission of the Bureau of Reclamation**

*The Bureau of Reclamation of the U.S. Department of the Interior is responsible for the development and conservation of the Nation's water resources in the Western United States.*

*The Bureau's original purpose "to provide for the reclamation of arid and semiarid lands in the West" today covers a wide range of interrelated functions. These include providing municipal and industrial water supplies; hydroelectric power generation; irrigation water for agriculture; water quality improvement; flood control; river navigation; river regulation and control; fish and wildlife enhancement; outdoor recreation; and research on water-related design, construction, materials, atmospheric management, and wind and solar power.*

*Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.*

A free pamphlet is available from the Bureau entitled "Publications for Sale." It describes some of the technical publications currently available, their cost, and how to order them. The pamphlet can be obtained upon request from the Bureau of Reclamation, Attn D-7923A, PO Box 25007, Denver Federal Center, Denver CO 80225-0007.